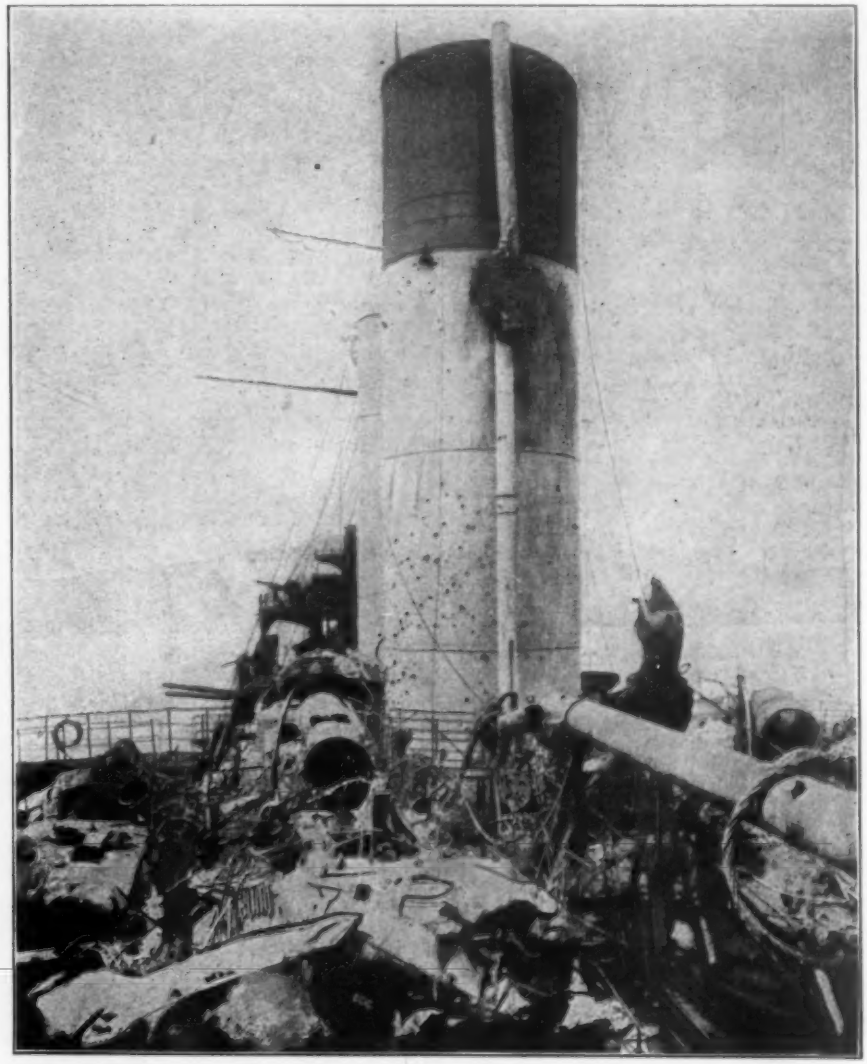
POPULAR MECHANICS

Vol. 7. No. 9. CHICAGO, SEPTEMBER, 1905. 10 Cents a copy. $1.00 a year



The Russian Battleship "Orel," Riddled by Japanese Fire in the Great Naval Battle of the Sea of Japan

FINEST GUNPOWDER PLANT IS IN JAPAN

The most complete, modern, convenient and practical gunpowder plant in the world belongs to the Japanese government and is located at Meguro, near Tokio. All kinds of ordnance and blasting powders are manufactured at this plant and 500 men are employed. Every department has its allotment of space, but not a foot is wasted, nor is there anything superfluous about the massive buildings and their equipment. A narrow gauge railroad runs along the main street for the full length of the factory grounds and overhead a wire-rope power-transmission connects all departments. Though modern in every respect, the plant is none the less Japanese in appearance. The corners of the roofs of the buildings turn up and there are many details in every department carried out in Japanese fashion.

Five to six thousand pounds of finished material is turned out daily, yet grounds and buildings are kept neat and clean. A detachment of soldiers patrol the plant and military precision and discipline govern.

STEEL STREET CARS

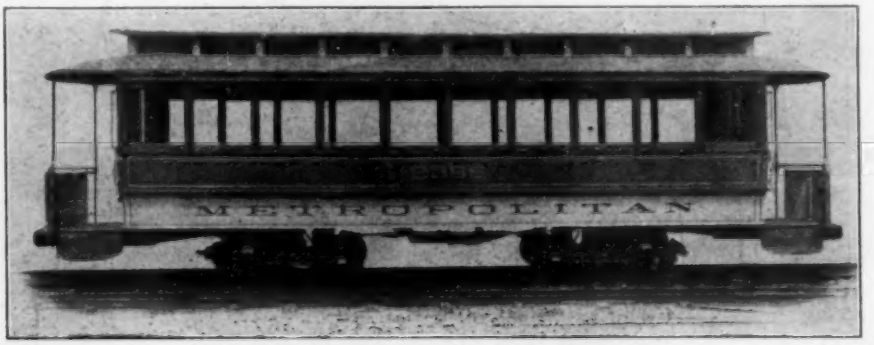
The growing tendency to build cars out of non-combustible materials has entered a new field, and the first steel street car has been finished and is running in the streets of New York. No wood is used in the construction of the car except the little required for the window sash, parts of the roof and the strips on the floor, and all these have been fireproofed. There is not the same necessity for a fireproof street car that there is for a steam car, as the passengers could always escape, but the street car, when stored in car barns, is one of the most combustible of all things, and when a car barn takes fire the loss is always heavy and usually total.

TELEGRAPHING PHOTOGRAPHS

Photographs can now be sent to a distance by telegraph. This means that a disaster occurring in New York tonight may be illustrated from actual photographs of the scene in the San Francisco papers tomorrow morning, instead of from the artist's imaginary pen pictures.

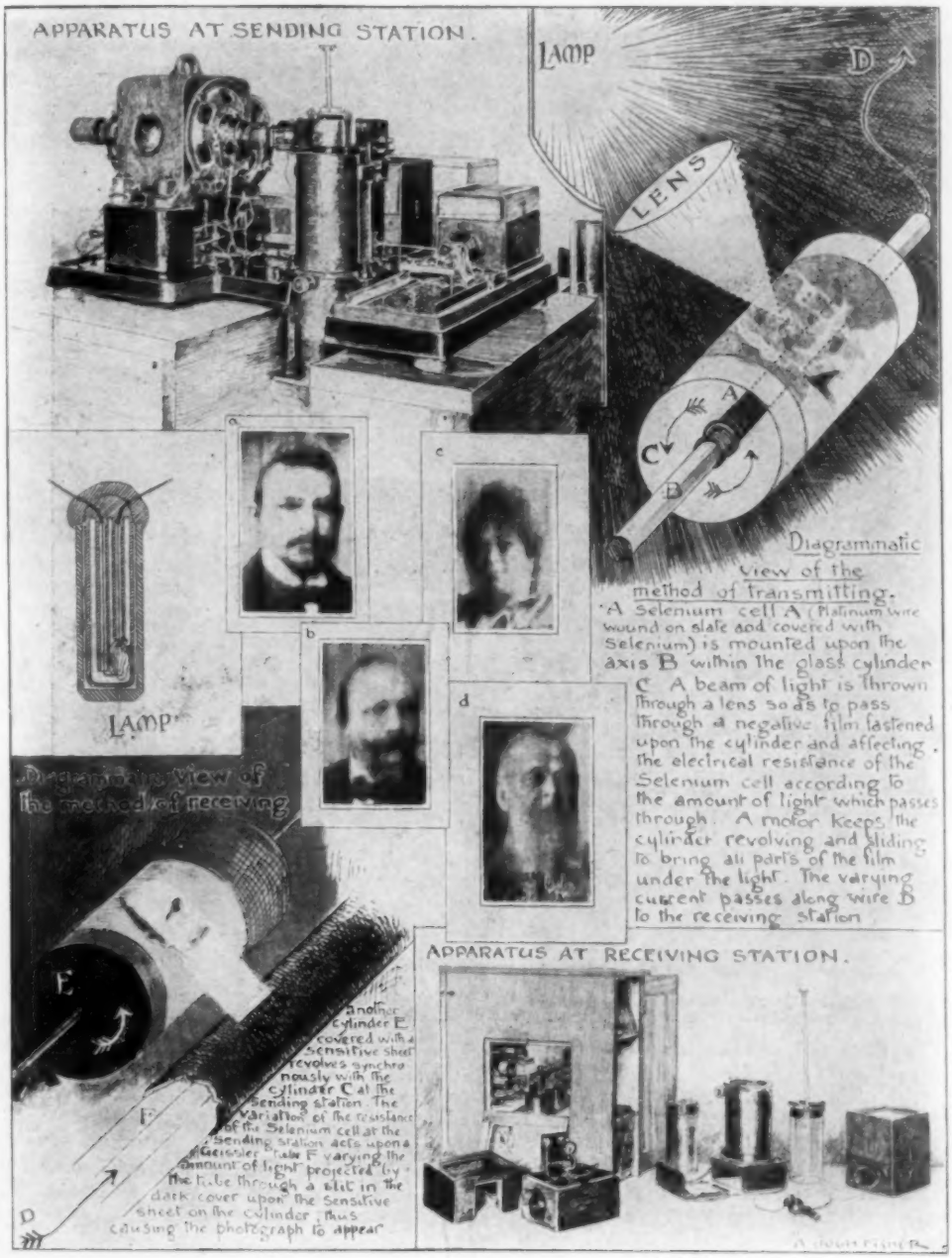
The instrument by which the telegraphic transmission of photographs, handwriting and photo-engravings is possible is the invention of Professor Arthur Korn, of Munich, and involves the use of a selenium cell, the electrical resistance of which varies according to the action of the light upon it. When an image from a photographic film is thrown upon this selenium cell the variable resistances are set up and transmitted to the receiving end of the apparatus. Here they vary the light of a Geissler tube which acts upon a sensitive tube as explained in the illustration, which we reproduce by courtesy of the Illustrated London News. The French telegraph service has been testing the photographic powers of the apparatus on a line between Paris and Rouen, for several weeks past and the illustration shows facsimiles of photographs actually sent by telegraph.

A special course of instruction for fitting boys to become apprentices in the shops of the Pennsylvania R. R. has been adopted by the board of education of Altoona, Pa., and will be taught in the high school of that city. Railway officials assisted in preparing the course.



First Steel Street Car Ever Built

APPARATUS BY WHICH PHOTOGRAPHS ARE ACTUALLY TELEGRAPHED


APPARATUS AT SENDING STATION.
LAMP
LENS
D
A
C
B
Diagrammatic view of the method of transmitting.
A Selenium cell A (Platinum wire wound on slate and covered with Selenium) is mounted upon the axis B within the glass cylinder C. A beam of light is thrown through a lens so as to pass through a negative film fastened upon the cylinder and affecting the electrical resistance of the Selenium cell according to the amount of light which passes through. A motor keeps the cylinder revolving and sliding to bring all parts of the film under the light. The varying current passes along wire B to the receiving station
a
b
c
d
LAMP
Diagrammatic view of the method of receiving
E
F
D
another cylinder E covered with a sensitive sheet revolves synchronously with the cylinder C at the sending station. The variation of the resistance of the Selenium cell at the sending station acts upon a Geissler tube F varying the amount of light projected by the tube through a slit in the dark cover upon the sensitive sheet on the cylinder, thus causing the photograph to appear
APPARATUS AT RECEIVING STATION.

Portraits a, b, c and d are Reproductions of Photographs Sent Over the Wire of the French Telegraph Co.

OCEAN TURBINES DECLARED TOO SLOW

The steam turbine has made such rapid progress considerable surprise will be occasioned at the report of Herr Struver, the chief constructing engineer of the North German Lloyd line. He declares as a result of test voyages he made on the Allan liner "Victorian" that: "It may do for small vessels, but it is not the thing for big ones. It does not save space or weight, and I did not discover that it saved anything in coal. The one advantage that can be claimed for it is that it has little or no vibration. But that does not offset the other disadvantages."

The difficulty of reversing is emphasized, the expert stating that it takes more than five times as long to reverse a turbine as a reciprocating engine.

However, the Cunard line have under construction two immense turbines which are expected to have a sustained speed of 24 knots an hour. It is said important improvements have been made which are guarded secrets.

MOSLEMS SACRIFICE EYES AT PROPHET'S TOMB

The pilgrim Moslem traveling toward Mecca has one supreme objective—the Prophet's tomb. When he has gazed on that he has, by some strange frenzy of belief, exhausted the delights of vision. He would insure that Mohammed's resting place be his last earthly sight.

Near the Ka-baah are men heating bricks white-hot in pans of coals. When the pilgrim has feasted his eyes on the (to him) blessed sight, he buys one of these white-hot bricks and with his face still turned toward the tomb, brings his eyes near the terrible heat of the brick and holds them there until his sight is destroyed. His agony is fearful, but he bears it till his object is accomplished. Then his sufferings stupefy him; the white heat of the brick dies out. In an hour or two he rises and takes his way—a blind man.

"They Gaze at White-Hot Bricks Until Their Sight is Destroyed."

France has electric lighthouses with lights of 30,000,000 candle power.

GERMANY TO SELL PNEUMATIC TOOLS HERE

German manufacturers are reported to have made a marked advance in their manufacture of pneumatic tools and compressors on account of recent important inventions. These tools have been introduced in the great Krupp works with success and a well-known firm in Frankfort insists its tools are now superior to the American, and considerably less expensive. A branch factory will probably be established in the United States, and the improved German tools put in competition with the American.

WORLD'S LARGEST STEAM TURBINES

The largest steam turbines ever built are under construction for the power house of the Brooklyn Heights Railroad. There will be two of them with a guaranteed output each of 16,000 brake hp., with dry steam at 175 lbs. and a vacuum of 28 in.

EDISON STORAGE BATTERY AGAIN PERFECTED

Two years have passed since the extravagant claims for a new storage battery were heralded by the daily press. Edison now announces that he has perfected the battery and that the problem of vehicle traction is surely solved. He claims his battery will store sufficient power to run a pleasure vehicle 100 to 150 miles an hour over good roads. The expectation is to operate a one-horse delivery wagon for 58 per cent of what it costs to do the work with a horse.

DETECTING FORGERIES BY THE MICROSCOPE

One of the surest means of detecting fraudulent additions to or changes in documents is by the use of the microscope. Mysteries in crime that have baffled detectives for months have at times been laid bare by the intelligent use of this instrument. The guilty fears this mechanical witness against him, as he fears no spoken evidence. A skillful lawyer can confuse and discon-

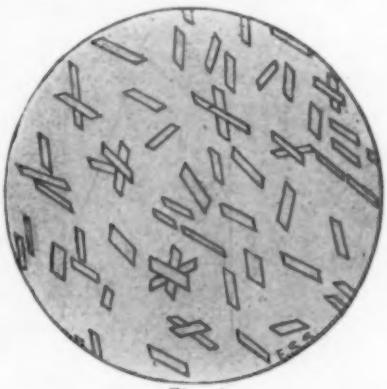


Fig 1

cert a human witness and tear to shreds the most damnific testimony; but when the microscope, silent, infallible witness, lays bare to the vision the immutable fact, he can only hold his peace.

Suspected blood-stains on clothing may be examined under the microscope, and their nature established beyond doubt. The stains are treated with a little alkali, evaporated to dryness and then heated with acetic acid, and a minute amount of sodium chloride, says Knowledge and Scientific News, London. If the stain is from human blood,

Fig 2.—$11 Converted into $17

small but characteristic crystals (haemin crystals) will appear. These crystals, much magnified, are illustrated in Fig. 1.

In forgeries the investigation resolves itself to the microscope and the trained observer. If a paper has been folded and afterward opened and an addition, change, interlineation, etc., made in it, a minute quantity of ink would follow the fold, did a single stroke of the pen cross it. A difference in the pen used by the forger is brought out under the microscope, or the strokes may be measured up to the ten-thousandth of an inch. The color of the ink may not be the exact shade, or may vary because of difference in the age of the writing.

Where figures or letters have been changed the joining of the new strokes with the old is certain to be imperfect. This is illustrated in Fig. 2, where in the numeral II one of the I's has been changed to a 7.

In Fig. 3 the words "in full to date" have been added and the fatal error made of allowing the cross of the "t" in the word "date" to pass over a letter in the signature. This, under the microscope, is incontrovertible evidence, no matter how well otherwise the forgery may have been executed.

The most painstaking forgeries are the most apparent when viewed through the microscope. In tracing the additions the pen has been lifted many times, perhaps; or the words or signature has been first traced in with a pencil, and these things proclaim themselves by imperfections that may not be doubted.

For work of this nature a 1/6 in. is a sufficiently high power. A good substage illumination by means of a condenser is required, however, and opaque objects must be illuminated by means of a bull's-eye or in some other way. Micro-photography was explained in the June number of Popular Mechanics.

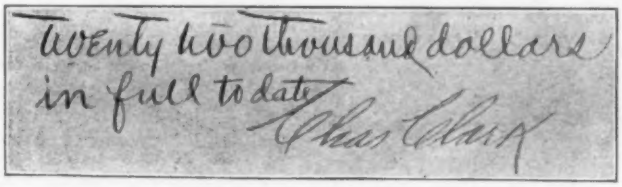


Fig. 3

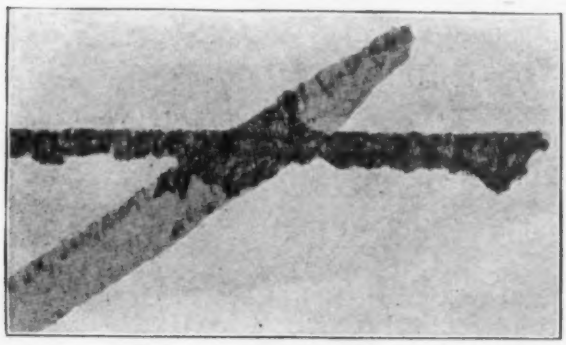


Fig. 4

The Stroke That Betrayed the Forger

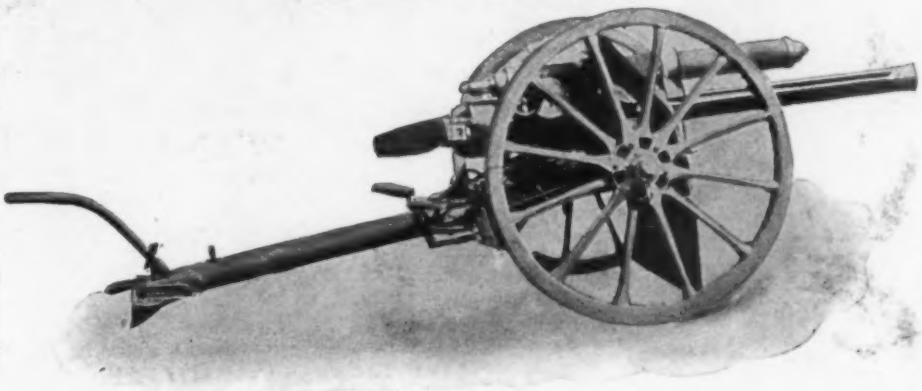
HOW AUTO SCORCHERS ARE CAUGHT

The suburban towns along Lake Michigan, north of Chicago, afford some of the finest automobile courses in the world. The local authorities have recently limited speed through their towns to about 15 miles an hour. Offenders are detected in this way: Two stations are established 1,000 ft. apart, connected by a wire. At each station an officer is concealed behind shrubbery. As a flyer passes the first station the signal is telegraphed to the other where a stop watch is started. When the offender passes the second station the time is taken and if the speed is too high a signal is passed to a third officer who makes the arrest.

Another scheme tried by villages is to build obstructions or bumps at street crossings. Spectators greatly enjoy watching unsuspecting motorists "bump the bumps."

THE MODERN QUICK-FIRING FIELD GUN

Stationary Carriage and Efficient Recoil Apparatus Essential Features---Types of Guns Used by Several Nations



British 18-pr. Quick-Firing Gun for Horse and Field Artillery

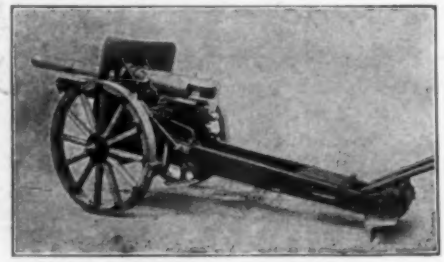
The great advantage afforded by the modern quick-firing gun is that, on firing, the carriage remains perfectly stationary, while a recoil apparatus handles the gun in recoil, and returns it to position with sights still aligned on the target. In the old equipment, gun and carriage were carried back several yards by the force of the recoil when the gun was fired, and the gunners were obliged to step aside to save themselves from injury. Then the gun and carriage had to be manhandled up to its former position and laid again on the target. Delay, fatigue, exposure, three elements that the improved army equipment tends always to eliminate wherever possible.

In the new type of field gun a buffer or cushion between the gun and the carriage places the shock of the discharge low down in the carriage with a great increase in steadiness of the gun. The gun itself when fired recoils on a slide and a flow of liquid, usually oil, past the piston-head checks its force. The compression of powerful springs also checks it, and when the force of recoil is expended, these springs, expanding, return the gun to position with its sights aligned on the target. On the end of the trail is a "spade" or triangular plate of steel, which is forced into the ground with the first discharge of the gun and holds the main part of the carriage stationary.

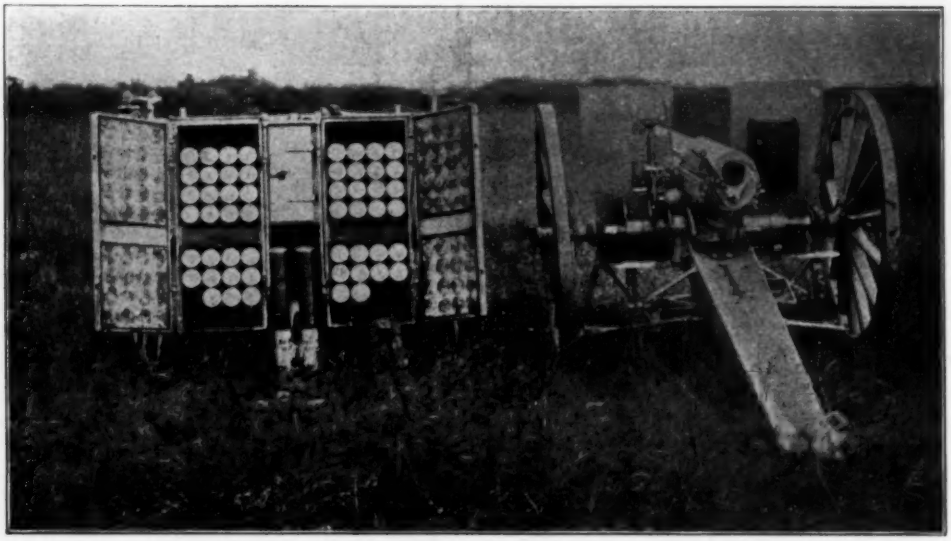
Austrian Field Howitzer

Telescopic sights, which are of great assistance to the gun layer, are used on the modern field gun, and it also has a nickel shield of great resisting power.

The British 18-pr. quick-firing gun is provided with a limber which enables the firing of as much as twenty-nine rounds per minute. The interior of this limber has circular pigeon holes each of which contains a shell and cartridge in one piece. The shell contains 364 bullets and is used with most deadly effect.



German Siege Gun

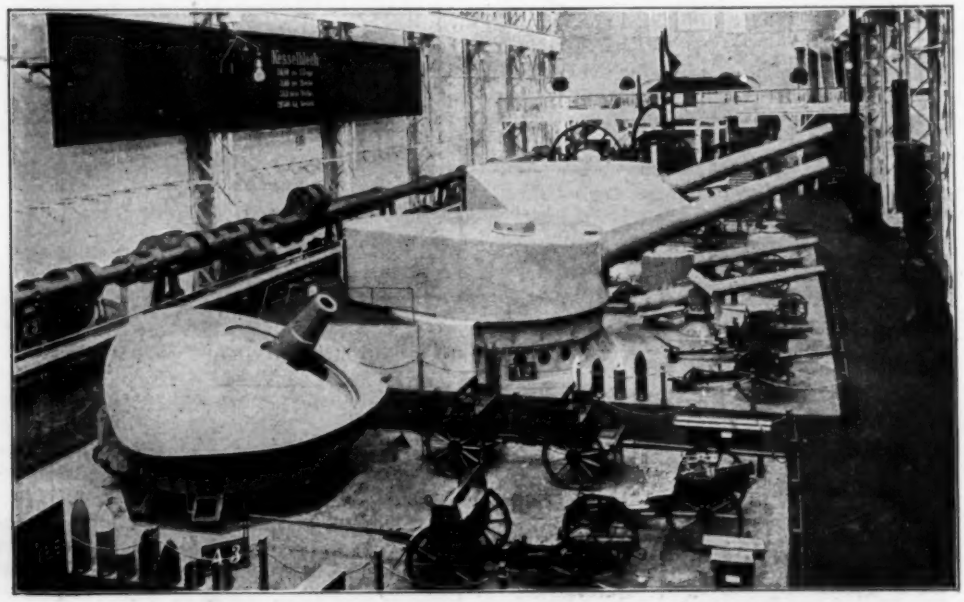


French Quick-Firing Gun Unlimbered and Ready for Action

The quick-firing gun in use by the various European powers differs but little in its essential features, though the artillerists of one nation do not always agree with those of another as to the most important advantages to be embodied in a weapon.

The German siege gun mounted upon a traveling carriage greatly resembles in appearance the modern field gun. When being drawn over the road, the gun is run back on the trail. The limber used with this gun is exceedingly small.

The French artillerists consider high velocity and long range essential, therefore their quick-firing guns are of great length. The gun after recoil is returned to firing



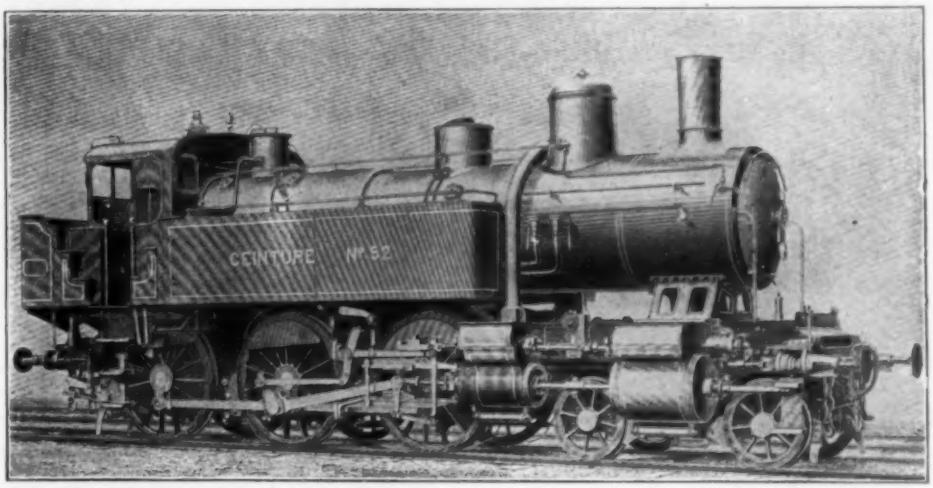
German Field Artillery and Big Naval Guns from the Krupp Works at Essen

position by compressed air. The details of this arrangement are a carefully guarded secret. The limber and wagon used by the French carry the ammunition in pigeonholes and during the firing one body of the wagon is up-ended and the lids opened outward to form a protection for the gunners preparing the shell.

The Austrian government has adopted the field howitzer, which is useful for indirect firing. The Austrian quick-firing gun is of wrought bronze with recoil tube mechanism and a detachable shield for protecting the gunners.

FRENCH TANDEM COMPOUND SUBURBAN LOCOMOTIVE

The illustration shows the new tandem compound tank locomotives for suburban work on the Paris Ceinture railway. These engines weigh 62 tons and require no tender. The drivers are 5 ft. 2.9 in. diameter. The high pressure cylinder is placed first in front of the leading driver, and is 12.9 in. diameter; low pressure cylinder 21.26 in. diameter; stroke 23.6 in. In starting, both cylinders can be made to work on live steam by moving a lever. Other details are: Fire grate area, 24 sq. ft.; tank capacity, 1,100 gallons; fuel, 3 tons; working pressure 227 lbs.



New French Compound Suburban Engine

When the British entered on the Boer war their field guns were out-of-date. New guns were supplied by the German firm of Ehrhardt, on short notice, and these guns have proven so serviceable that the British army has adopted them extensively into service. Ehrhardt steel, of which these guns are made, is said to offer great resistance to the strain of rapid firing.

HILLS TO STOP TRAINS

One of the elevated roads in Chicago is rebuilding its track and will raise the rails at stations to make a "hump" 3 ft. high. This will not only assist in bringing the train to a stop, but the down-grade assists in starting again.

Fifty thousand tons of welded chain were made in this country last year, making it the largest producer in the world.

SIDE LIGHTS ON VESSELS

Red and green side lights on steamers were first required to be carried by the British Admiralty by act of Parliament, January 1, 1847, and the regulation was adopted by the United States navy in 1848. British sailing vessels, however, were not required to carry these lights until 1852. The British shipping act or rule of the road went into effect for British shipping in 1862 and was adopted by the United States in 1864 and is in substance the recognized rule of the road at sea throughout the commercial world. Act of Congress of March 3, 1849, provides that steam vessels under way at night on the Great Lakes shall show the white, green and red lights substantially as at present.

EXPERIMENTS WITH ARTIFICIAL WINGS

English Scientists' Feathered Craft Has Lifting Power of 100 lbs. in Each Wing

Several English scientists are conducting some interesting and promising experiments with a pair of artificial wings operated by a 3½-hp. gasoline engine. It has been found that in a bird the wings are so shaped, and the feathers in the wing so shaped and located, that during the upward movement of the wing there is the least possible resistance to the air, and even that considerable air actually passes through the wing. On the downward stroke the reverse is true, as the feathers close and

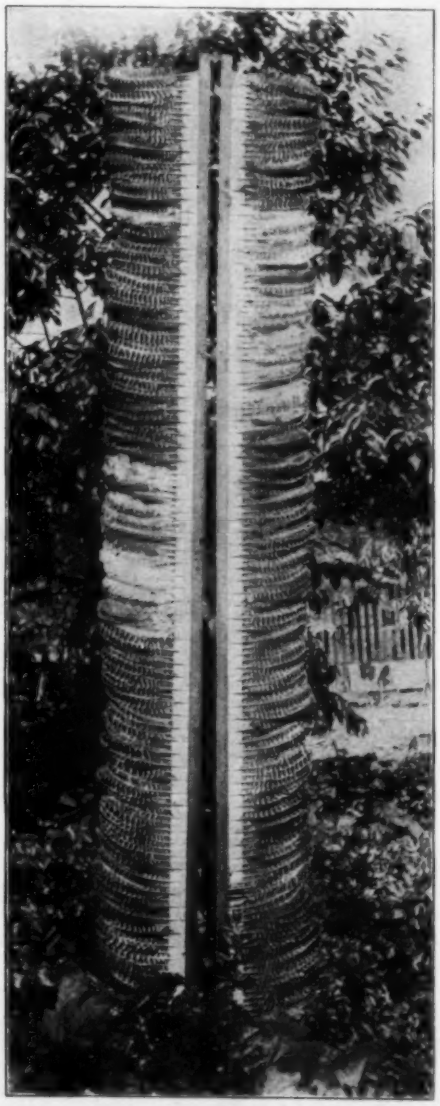
Ready to Be Launched on the Air--Ohio

not only afford a lifting motion but a forward one as well.

As a result of these observations they constructed a pair of mammoth wings as nearly approaching those of a crow as possible. These wings were hung from a frame in such a way that a rise of 2 ft. was possible. To the wings was attached the engine and machinery for wagging, and the whole was mounted on four wheels to permit a forward motion. The wings measured 20 ft. from tip to tip and had 60 sq. ft. of surface, and were operated at 100 flaps per minute. It was found that at this speed the wings lifted bodily the engine and machinery, weighing 232 lbs., the limit of the confined space—2 ft. In other words, each wing was estimated to have a lifting power of more than 100 lbs., together with a considerable forward movement.

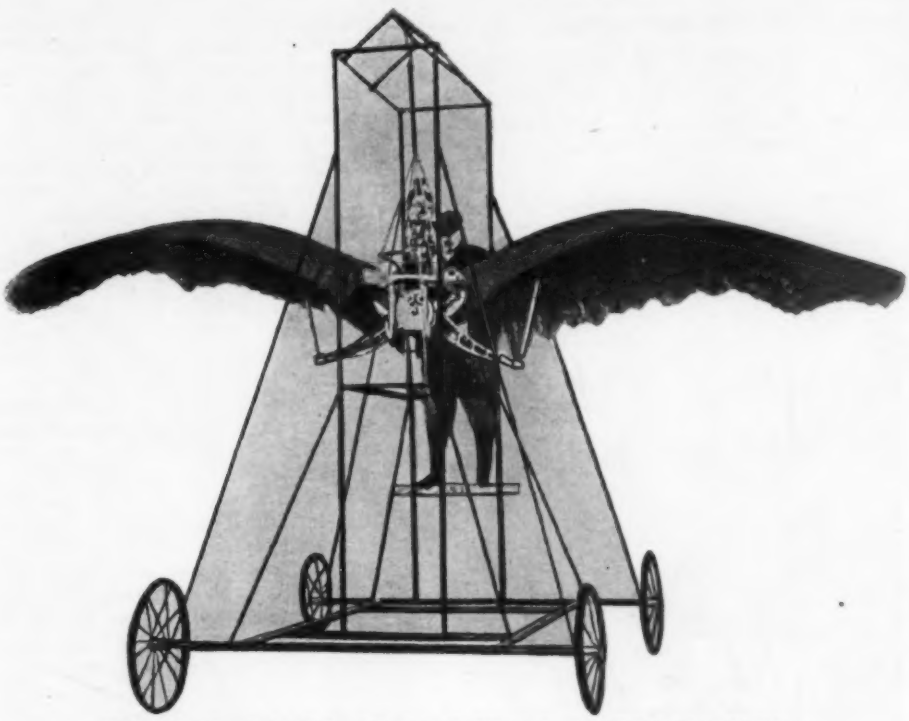
An Ohio inventor is working along somewhat similar lines, except that his wings are made of real feathers, while in the English experiments the "feathers" were artificial.

The American inventor, C. E. Irish, used strong turkey wing feathers in constructing his flying-machine. Altogether the machine has 26 pairs of wings and thou-



One of the 26 Pairs of Wings--Ohio

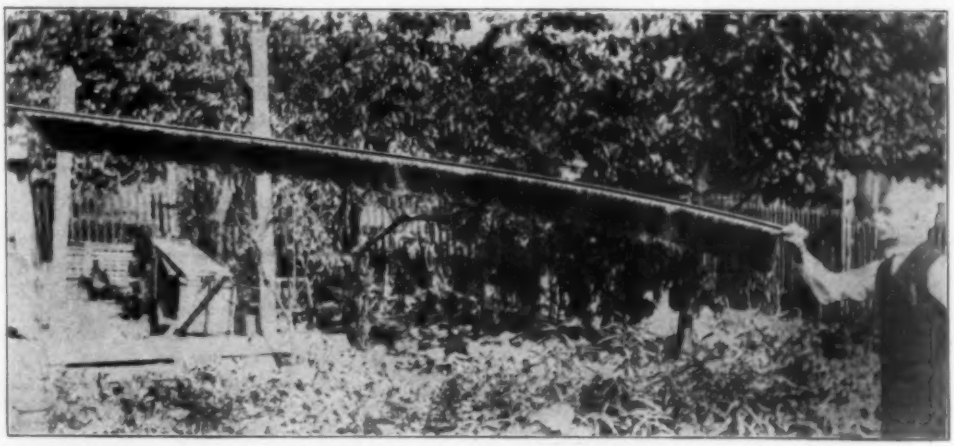
sands of feathers were required for them, every feather being glued into place separately. The wings are attached to a light framework, shaped somewhat like the breastbone of a bird. The machine is mounted on wheels and to start it must first be run down an incline, then launched on the air by taking an upward tack.



"They Constructed a Pair of Mammoth Wings."---English Flying-Machine

No engine is provided for propelling this craft, the inventor declaring that by a scientific study of birds and application of their principle of flight, he will eventually accomplish with his machine what every one else has fallen short of: The free, untrammeled navigation of the air. In flight, the control of the machine will depend entirely on manipulation of the wings.

Mr. Irish proposes to utilize gravity by making a sudden upward tack every time the machine gains a certain degree of acceleration by downward flight. His project, though still a dream, forms a unique chapter in the certain evolution of aerial navigation.

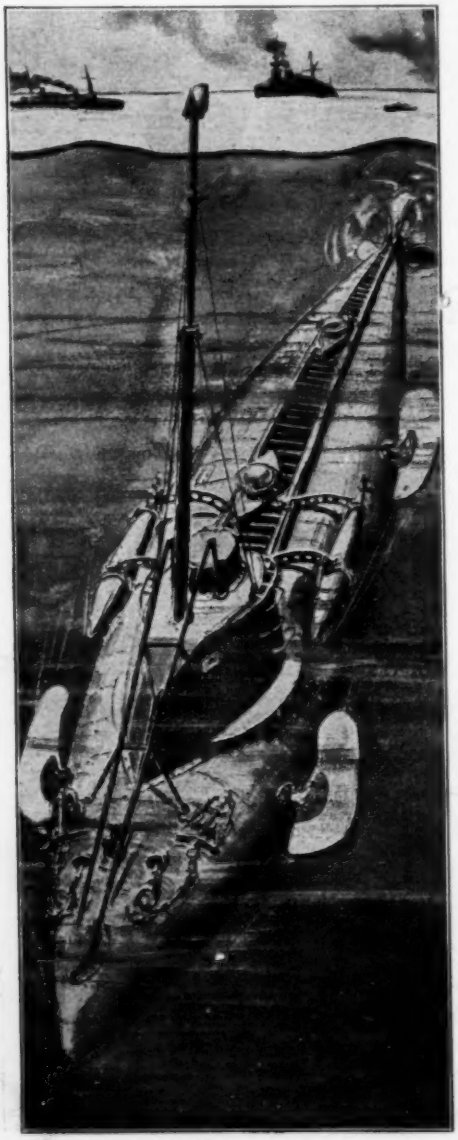


A Single Wing--American Experiment

DEVICE TO RESCUE SUNKEN SUBMARINES

Submarine Sailing Most Perilous of All Work Undertaken by Army or Navy

The operating of a submarine boat is today the most perilous of all duties required of soldiers or marines. Every time the officers and engineers enter one of these craft and hear the hatches close above them, they do so with the full knowledge that they may never return alive. The service requires not only men who are highly proficient in the operation of the delicate machinery which operates the craft, but men who do not know what fear of danger is. The failure of any one of a hundred parts of machinery means death in its most terrible form. Not annihilation in an instant, as with the bursting of a shell, or a magazine, but death painful in the extreme, and extending over several hours, as inch by inch the supply of air is steadily consumed, until finally the last vestige of vitality is exhausted and the victim who has lain helpless through an eternity of torture sinks into a grateful unconsciousness.

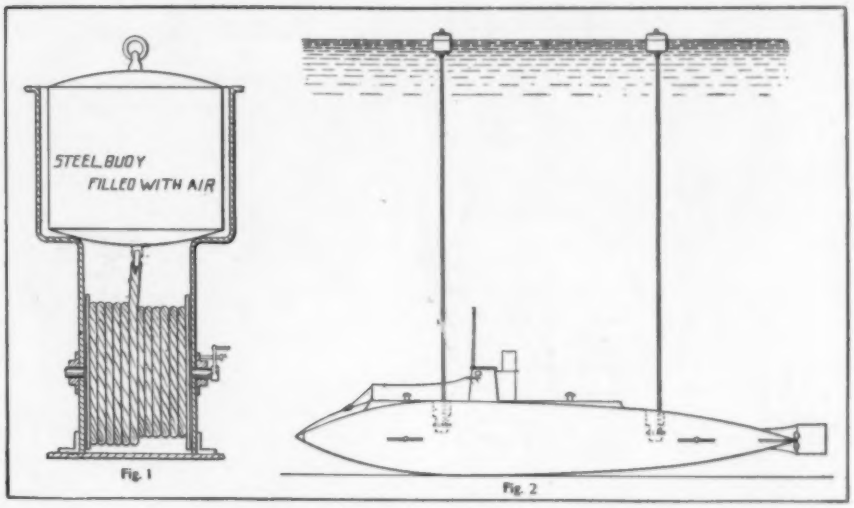


The Lost "Farfadet"

The four disasters to submarine boats during the past few months, with the accompanying terrible loss of life, is causing engineers to seek some method of relief. The accident to the French submarine "Farfadet," in which the 13 occupants died, was especially heartrending. When the dive was made one of the hatches was poorly secured and water poured into the vessel, which sank to the bottom in deep water. Divers who were sent down reported signals from the men confined for two days, showing they lived until the supply of compressed air was entirely exhausted. Time and again the boat was brought to the surface, only to slip from the hoisting ropes and chains before the prisoners could escape. Meanwhile the agonized members of their families stood on the docks day and night, watching the efforts of the wrecking crews.

The "Farfadet" was maneuvring in the harbor of Sidi Abdallah, Tunis, and descended at 9 a. m. on July 6, and was finally recovered on July 15. Every attempt at hoisting with ropes and chains failed owing to the inability to securely attach them. A floating dock was finally sunk, the submarine pulled onto the dock, and the dock inflated with air, when it came to the surface with its burden.

An English naval architect, S. H. Terry, now suggests the use of two steel buoys, one to be carried in a recess in each end of the boat. These buoys to be 3 ft. diameter by 2 ft. 6 in. deep, with a lifting power of 500 lbs. each. To each buoy would be attached a steel rope with a breaking strain of 120 tons, the rope wound around a drum. When a submarine becomes disabled and unable to rise, levers within the boat would release the buoys which would immediately rise to the surface,

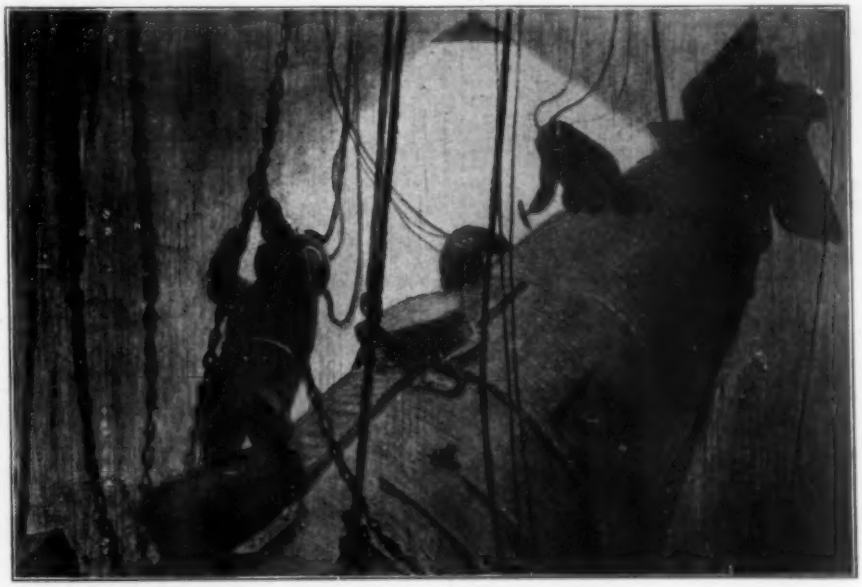


Proposed Plan to Rescue Sunken Submarines

taking the ropes with them. By means of these ropes almost any other boat could raise the submarine without loss of time. The buoys would also greatly facilitate the location of the boat. Mr. Terry says:

"As it seems scarcely likely that the field of work of submarines will ever be in deep water—deeper than, say, 120 ft. to 150 ft.—and as, if they work in water deeper than this they may possibly collapse, I have only provided for salving them from a moderate, reasonable and workable depth—such a depth, in fact, as that in which those lamentable disasters usually take place. Had such lifting powers been available in the case of the A 1, near the Warner lightship, or in the A 8, the vessels could have been at once within half an hour, brought to the surface, and all lives saved.

"I abstain from all comments on the structure of the boats which renders the opening of a hatch nearly awash a necessity



Divers Trying to Communicate with the Imprisoned Crew---Placing Slings for Raising the Vessel

when men have to pass in and out, and on the regulation which compels them to wear a dress in which it is next to impossible to swim.

"It is evident that when submarine boat drill takes place, a salvage vessel, with all diving apparatus, and with lifting apparatus should accompany the boats."

LEARNING TO RUN A TROLLEY CAR

Less skill is actually required to run a trolley car than to drive a horse car, especially if the trolley car has air brakes, as most of them have in these days. At the same time there are certain essentials without which a man is not safe to trust out on a busy street with such a forcible affair as an electric car with full power turned on.

The horse car drivers used to learn on a little piece of unused track kept for the purpose back of the street car barns; the motormen on the large city lines learn in a school provided for the purpose by the company. In this school a row of controllers such as are found on the street cars, are set up on a platform and here the students, 10 at one time, are instructed in the arts of starting and stopping a car and working the hand and air brakes. The instructor also stands on a platform where he can watch the work of the men as he gives the bell signals again and again until the good

Courtesy St. Ry. Journal

Teaching Motormen

ones are retained and the dull ones rejected. The most difficult part is to teach the men how to operate their cars without using more power than is necessary.

All electric arc lamps in London will be replaced with incandescent gas lights for street lighting. With the improved gas lamp, it is said, ten times as much light is procured as with the electric arc light, at the same cost.

PORTABLE SUCTION GAS PRODUCER AND ENGINE

The success of the suction gas producer in connection with stationary engines in England has led to the manufacture of a portable type. The outfit illustrated is 12½ h. p. and weighs 5 tons. The truck frame

Portable Gas Producer

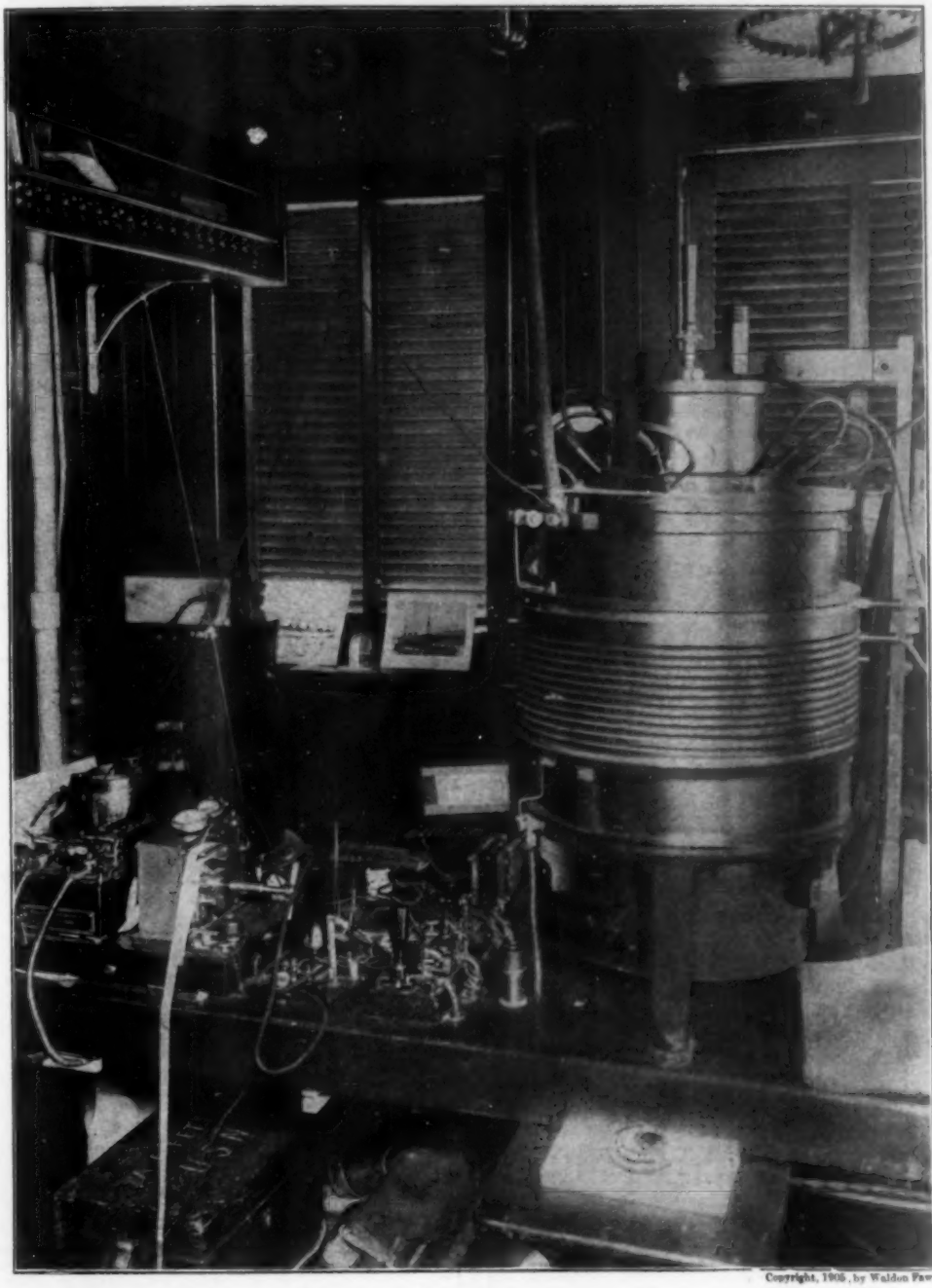
is steel with as much of the machinery as possible carried close to the ground. The gas producer is air cooled, thus greatly reducing the amount of water required. A small quantity of water from the canopy is allowed to flow into the coke scrubber, so as to keep the coke moist, and more thoroughly to cleanse the gas before passing to the engine.

TUNNELS TO REPLACE SNOW SHEDS

Millions of dollars will be spent by the Central Pacific railroad in constructing tunnels through the Sierra Nevada mountains. This will be done to save the great sums annually required to maintain the present snow sheds and at the same time secure shorter routes and reduced grades. Five great tunnels are already decided on, one of them five miles long. The snow shed was considered a marvel of engineering when first established, but will soon become a thing of history.

In 1904 this country produced 27,644,330 tons of iron and consumed in manufactures 30,224,910 tons. In 1902 we consumed 35,886,921 tons (highest record ever made); and in 1903, 34,232,399 tons.

WIRELESS TELEGRAPHY IN THE AMERICAN NAVY



Copyright, 1905, by Walden Fawcett

The Wireless Telegraph Station Installed on Board the "Chicago"

CURING OF CEMENT BLOCKS

[Excerpts from paper by James Wimmer, read before the Iowa Cement Users' Association]

I, of course, consider nothing but the perfect block. This means sharp, clean sand, good cement, proper proportions, thoroughly mixed, thoroughly tamped, and placed in the shade. A block well made but badly cured, is worthless, and a block poorly made and well cured is worthless, so great care must be taken in all stages of block manufacture.

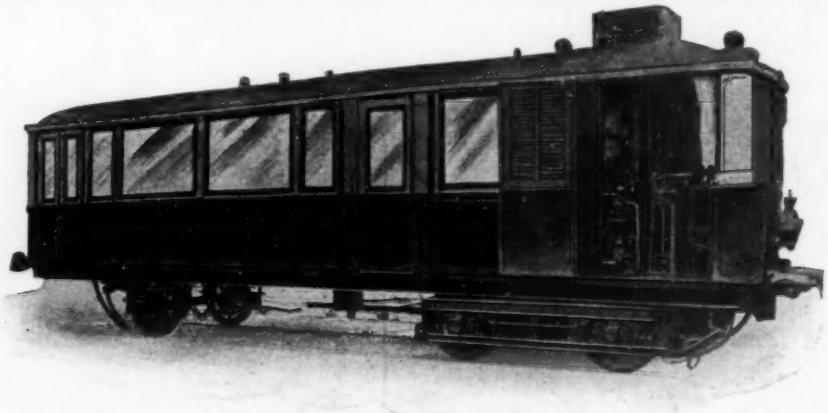
One of the most important features of block manufacturing is the curing process. A block must cure uniformly. The primal requisite in proper curing is water, and plenty of it. No stated time can be given for beginning the sprinkling, as all depends on the atmospheric conditions. Some days you can begin sprinkling three hours after the block is molded, while at other times five to eight hours will elapse before you can apply water with safety. The moment you detect the face of outer surface turning light, it is a sure sign the blocks need water, and they must be sprinkled as often as this is noticed. You can not make them too wet. This process should continue for at least forty-eight hours, or until the block can be removed from the pallets, lathed and piled. By lathing each tier the blocks dry uniformly. This water cure continues from five to eight days. All of our sprinkling is done with hose and spray, and this is carefully attended to by one man. We have found that blocks can only be successfully cured by one experienced man. What is everybody's business is nobody's business, and the blocks can not and must not be neglected.

We hear of some people who advocate the process of curing blocks under water. My actual experience tells me this is a failure, for two reasons: First, it is not practical; second, it means extra labor and expense. Imagine what an area it would require to submerge the product of five days' labor, which means about 600 blocks from the average machine.

COMBINED LOCOMOTIVE AND CAR

An English firm is building some novel combination locomotive-cars for the Hungarian State Railways, with the prospect that the same type will be adopted on English roads for light service. The car weighs 14 tons, of which one-half is on the drivers, and carries 33 passengers in two compartments. The engineer and machinery occupy a third compartment, while a fourth is used by the conductor and "guard."

The engine is a high speed horizontal compound with cylinders 4.7 in. and 7 in. diameter with 5½-in. stroke, and runs at 600 r. p. m., producing 35 h. p. The engine is suspended from the truck and drives by means of a spur gear, of which there are two for securing power in starting, or speed when running, as required. The gears are thrown in or out by a friction clutch. The boiler is vertical 32 in. diameter, 45 in. high, and fired from the top through a central tube; it carries 270 lbs. steam. The car makes 30 miles an hour, using 6½ lbs. coal and 4½ gal. water per mile, and is intended for short or branch lines or for late service where it would not pay to operate a train. Cost of operation is 15 cents per mile.

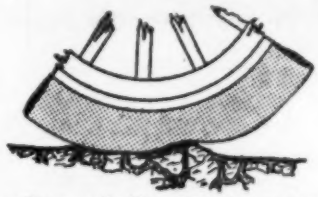


Weight 14 Tons; Speed 30 Miles; Carries 33 Passengers

EFFECT OF IRON AND PNEUMATIC TIRES ON ROADWAY

Dust on roadways is largely caused by the chopping action of the sharp pointed steel shoes worn by horses. If the horses could be removed and all wheels rubber-tired there would be comparatively little dust. The effect of an iron tire is to dig into the softer portions of the road surface, and to crush uneven portions. Technics, London, illustrates the effect of the two tires. The pneumatic tire flattens

Iron Tire Crushes



How a Pneumatic Tire Absorbs an Obstacle

like a ribbon, and adjusts itself to the inequalities of the surface, but in resuming

How a Pneumatic Tire Thows Up Dust Without Pulverizing the Road

its shape throws off the particles which have been raised by the vacuum it produces.

An old man at Mirror Lake, Wis., employs a unique method of propelling his boat and fishing at the same time. At the stern of the boat is a paddle wheel like those used on river steamers. A chain runs on cogs from the wheel to a crank, which the old man turns with one hand while he handles his lines with the other.

The structural steel business is lively this year, and it is said that the demand for material for railroad bridges exceeds former years considerably. Other branches are likewise rushed. There is much new railroad work and the orders for equipment and track supplies are pouring in.

JAPANESE TEACHING RUSSIAN TO RUSSIANS

One of the most unexpected things that has ever occurred in connection with any war is now being successfully done at Himeji, Japan. At this town are confined the 70,000 Russian prisoners of war, mostly from Port Arthur, nine-tenths of whom are illiterate. With a desire to improve their minds the Japanese government has established in the prison a school to teach the illiterate Russians *their own language.* The Japan Daily Times says: "Thanks to the teaching, those soldiers who were totally illiterate are now able to write letters to their homes. It is stated that the authorities of the quarters are receiving inquiries from Russia asking if the letters were really written by the senders."

This certainly is one of the most unusual events ever produced by any war, and is as creditable to the Japs as it is valuable to the Russians. The Kobe Daily News now issues an illustrated weekly called "Japan and Russia" for the prisoners. "The magazine is to keep the 70,000 Russian prisoners now in this country informed about the general situation at the front and the attitude of the various powers in connection with the war, as well as to acquaint the prisoners with the characteristics of our people, thus preparing the way for mutual friendship and confidence between the two nations after the restoration of peace. The first number contains nearly twenty beautiful illustrations in half tone."

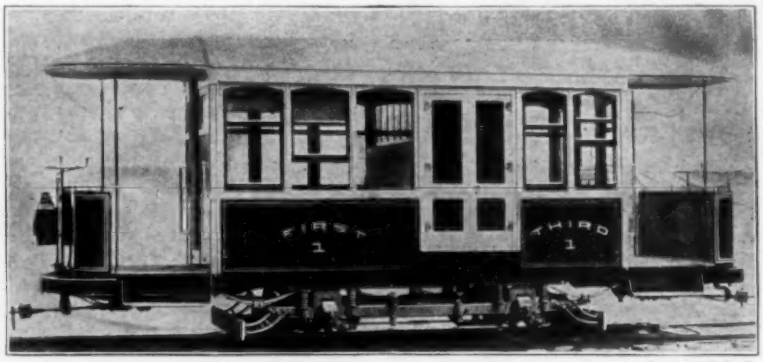
No wonder the Russians are not over anxious about being released.

SAULT SAINTE MARIE CANAL

With suitable honors in which high government officials of the United States and Canada participated, the fiftieth anniversary of the canal was celebrated on August 3. This canal is the gateway to Lake Superior. The first canal was projected by S. T. Mason, the first governor of Michigan, in 1839; work was begun in 1852 under government control, and completed in 1855. The locks have been twice reconstructed and enlarged. The American lock is 800 ft. long and 100 ft wide; the Canadian lock 1,000 ft. long. No tolls are charged. During the past 10 years 253,000,000 tons passed through the canal, a much larger traffic than passes through any other canal in the world.

QUEER STREET CARS FOR AFRICA

An American firm of street car builders are shipping some odd street cars to Cape Town, South Africa. These cars are divided into three compartments, one for first-class passengers, seating four people, and making a room about 6 ft. by 7 ft.; another compartment for baggage; and a third for third-class passengers. What happens to the second-class passengers is not stated; perhaps they get out and push. The body of the car is 15 ft. long, with windows that can be pushed out of the way, making a semi-open car in pleasant weather.



Courtesy Brill Car Co

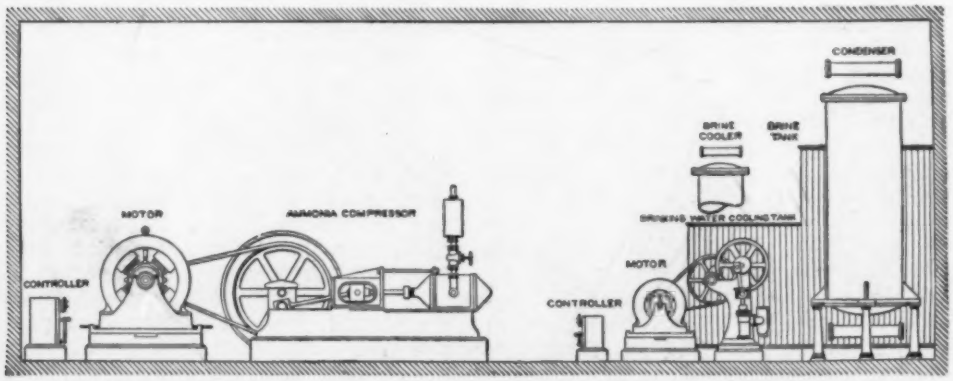
Cape Town, Africa, Street Car

REFRIGERATION FOR OFFICE BUILDINGS

The modern sky-scraper office building, with as many acres of floor space as a good-sized pasture, is not only heated and lighted with its own plant, but in each of the hundreds of offices hot water and ice water are supplied. Filtered ice water flows day and night throughout the year by the simple opening of a faucet. But not a pound of ice is ever taken into the building; the cold water, like the hot water and the electric light, has its own individual "plant."

The refrigerating plant is similiar to those used in cold storage houses. Such a plant in one of the new buildings in Chicago has a capacity of 800 gallons of filtered drinking water per hour at a temperature of 35 deg. The temperature of the water on the 20th story is 45 deg. The refrigerating machinery is operated by electric motors, and after the water is cooled it is pumped by electric pumps through pipes to all parts of building.

From drinking warm water from a jug brought out to the harvest field by a barefooted boy, to imbibing filtered ice water at 40 deg. in the palatial office of the up-to-date building is a long step, but many of the best men now occupying luxurious quarters have made the trip.



Water Cooling Plant in the Largest Office Building in the World; Chicago

WHY RAILS FAIL IN SERVICE

A good rail is of the utmost importance, but very few of the millions who ride in safety over the thousands of miles of steel have any conception of the skill and care required to produce a first quality rail. When rail is being rolled a careful selection is made not only of the steel itself but any rails which show imperfections are either thrown out or sold as "seconds", and used for laying side tracks or on lines where the traffic is light or infrequent.

Notwithstanding the rigid inspection through all the process of making, shipping and laying, a rail may be perfect to all appearances, and yet be unsound within. This condition can only be discovered by sawing up the rail, making it unfit for use, or by demonstration under actual service. Fortunately unsound rails rarely ever give way all at once, but show their unfitness by a gradual breaking down, so that there is opportunity to take them up before a condition of serious danger occurs.

An eastern road, which has made unusual records, covering a period of many years, gives the following as the chief causes of rail failure in service: (1) Pipes in the steel; (2) Presence of a considerable proportion of blowholes; (3) Excessive segregation; (4) Coarse granular structure; (5) Rough handling.

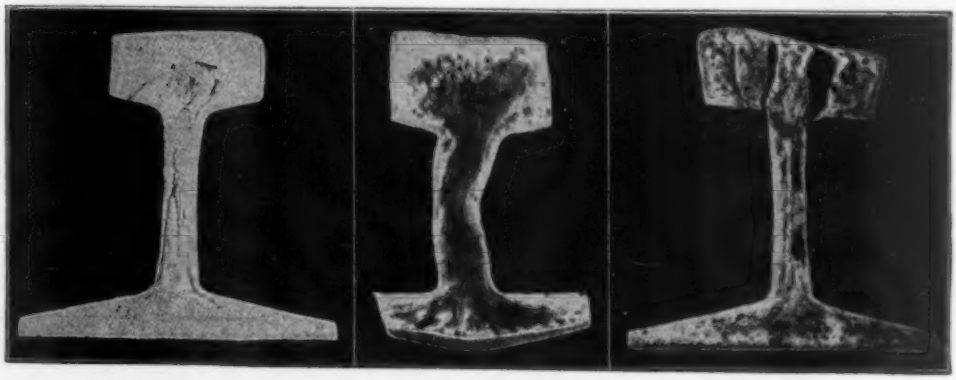
Robert Job, chemist for the Philadelphia & Reading Ry., says: "To sum up, the results of our investigation indicate that the greater part of the difficulty which occurs today with rails under heavy traffic is due to unsound condition of the steel, a condition which existed in comparatively slight degree in the earlier rails."

BIGGEST AIR-SHIP EVER BUILT

The biggest air-ship ever built made a successful ascent to 2,400 ft. from the Alexandra Palace, on July 22. The ship has a cigar-shaped gas bag 150 ft. long, beneath which is a bamboo frame and deck 123 ft. in length. It is propelled by two 50-hp.

100-hp. Air-Ship

gasoline engines, which drive four propellers. The ship was built for the English War Department. Four aeronauts made the ascent, the ship having the greatest lifting power of any yet built. The descent was successfully accomplished, but, owing to an accident while landing, the balloon had to be cut open and the car was wrecked.



Pipe in Steel

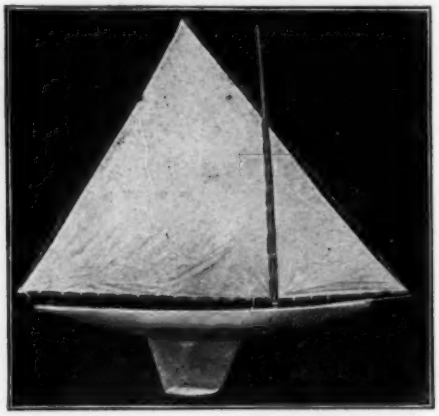
Unsound Steel--Service Five Weeks

Unsound Steel--Service Five Months

HOW TO BUILD A MODEL YACHT

By Alex. E. Quinn, of San Francisco

Within the past few years the interesting and instructive sport of model yachting has become very popular in the sporting circles of San Francisco. This popularity has been caused principally by the efforts of a lately formed model yacht club, in the affairs of which some of the foremost citizens of San Francisco have taken a great interest. Quite a few of these men are naval architects, marine engineers, etc. Another vital reason for the great hold this sport has taken upon the San Francisco public, is the donation to the city of a fine lake, especially for the model yachting, by one of



The Finished Model Yacht

our most public-spirited men, Mr. Spreckles, whose name the lake now bears. Lake Spreckles is situated in the beautiful Golden Gate Park, is about 250 ft. in diameter at its widest part, and around a portion of its edge a stone walk is laid, upon which the yachtsmen can easily go around from one side to the other.

On a Sunday or holiday morning you can see nearly half a hundred yachts of all sizes, shapes and rigs, sailing upon this lake, and the close contests between the different yachts furnish excitement and amusement for the large crowd of interested spectators.

Mr. Geo. W. Gickie, formerly manager of the Union Iron Works, presented a trophy cup to the San Francisco model yacht club, and this cup is held by the owner of the speediest boat in each special race; besides this cup many other prizes of all descriptions are won or held by the different competitors.

The yachts permitted to enter these races must not be over 50 in. on the load waterline, with a corresponding sail area of generally not more than 2,500 sq. in., being classified according to size, etc., in three classes.

The following will give an outline of how to construct one of these yachts. The first step is to build the hull, the best wood for this being cedar, and the best metal aluminum, the cedar boat (which will be described) is cheaper, but takes a longer time to build, as the wood has to be thoroughly seasoned, then shaped exactly on the outside to template taken from the lines of the plan; after which the inside must be hollowed out until the shell is about $\frac{3}{16}$-in. thick, except along the keel, where it is advisable to leave ½ in. of wood for fastening the aluminum fin which takes the lead, and along the deck line where it is best to leave ¼ in. thickness for fastening the deck to the hull. In order to make the hull perfectly watertight, it is best to first give it three coats of shellac on the inside, then to glue strips of light canvas or linen upon this and then give two or more coats overall. For a boat of 70-in. overall, 50-in. on the load waterline and a beam of 10 in., the hull must not weigh more than 7 lb. after the aluminum fin, Fig. 1, is fitted; the boat complete must not weigh more than 27 lb.

For ease in transportation the mast should be made portable, at the same time, however, the opening in the deck for the mast must be watertight, and this result is best

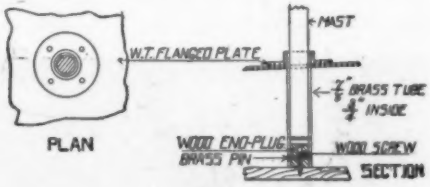


Fig. 2

obtained by placing a piece of ⅞-in. brass tubing over a plug secured to the keel by a wood screw (See Fig. 2). This tube is made long enough to project through the deck. To prevent turning, a pin is put through tube and plug. The mast may then be put in place or removed very easily. An aluminum flanged plate bedded in white lead is placed on the deck where the tube comes through in order to make it watertight.

The bow-sprit, (Fig. 1) is best made portable also, and the most suitable wood for this part is oak. The bow-sprit can be fitted to the deck of the boat by means of two brackets, the one at the end of the bow-sprit made with three legs, the other bracket need only be a common strap bracket. The material most suitable for these brackets is aluminum, as this metal is lightest and is not affected by water.

All the rigging fittings, such as rings, screw eyes, pins, etc., had best be made of aluminum also. Two aluminum travelers one for the gib and one for the mainsail, must be fitted to the deck, so as to give the booms enough play. Both should be the same length, so the mainsail and gib will be on the same angle. This angle depends on the strength of the wind and can be found by experience in sailing boom stays to be fitted, so that they can be adjusted accordingly.

The best material for the sails is Lonsdale cambric. If care is taken to have the edge of the sail running from the gaff to the end of the boom, in the selvage, no trouble will be experienced on account of slack or baggy sails.

The center of effort of the entire sail area must be about 2 in. or more forward of the center of buoyancy of the hull, because these model yachts are fitted without rudders and this is necessary for them to sail straight.

The lead for the size of boat mentioned is best cast in cigar shape and must have its center of buoyancy directly under the center of buoyancy of the hull, because if these two are not in correct relation with each other, the waterline of the boat will change, making the hull dip either forward or aft.

The aluminum fin on which the lead is fastened is best attached to the hull of the boat (if boat is finished natural wood) by means of two aluminum angles ¾ in. x ¾ in., or if the boat is to be painted or enameled, by cutting slots 1 in. deep and 1 in. apart, or as wide apart as will come out even, in the upper edge of the fin and then bending the squares alternately to right and left. The hull can then be recessed in way of these squares, in each of which three wood screws fastening it to the hull had best be put; in this way a very smooth job can be done. The lead may be fastened to the aluminum fin by slotting it lengthwise about half the diameter deep, then boring two or more holes through lead and fin, and fastening the lead to the fin by either bolts or

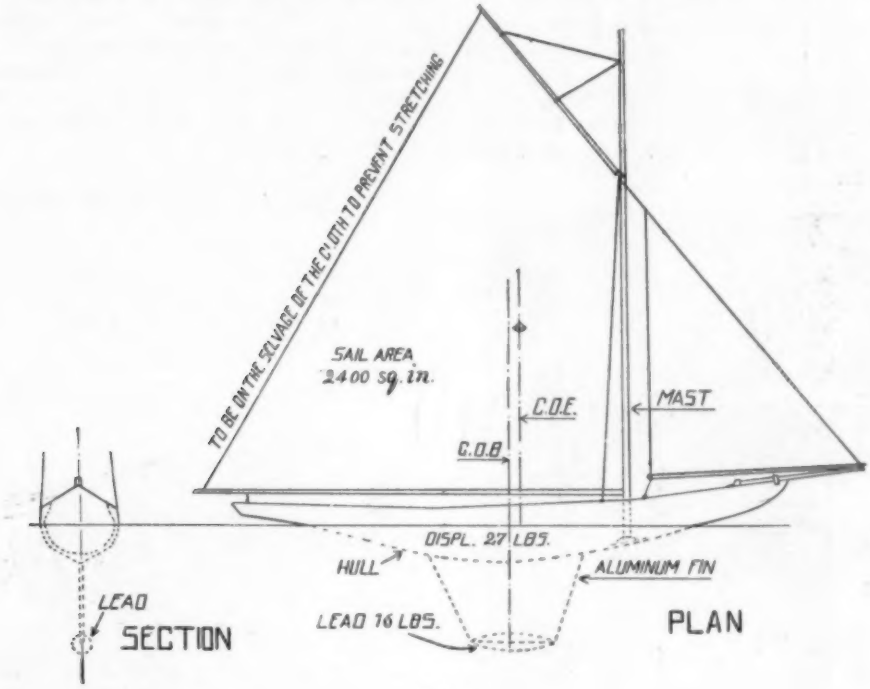


Fig. 1

wood screws whichever you may prefer. In this manner the lead is easily made portable and its absence often prevents injuring the boat when not in use.

After your boat is complete it should get three or more coats of schellac, and the same number of coats of varnish, leaving at least an interval of two days between each coat. Before the last coat the boat should be rubbed down thoroughly with pumice stone so as to get a smooth and glossy surface.

HOW LIONS ARE CARRIED

For some reason, not stated, the express companies object to carrying lions as they do large dogs with simply a tag attached and the charges guaranteed. Each spring and fall a large number of these fierce animals have to be carried to or from winter quarters.

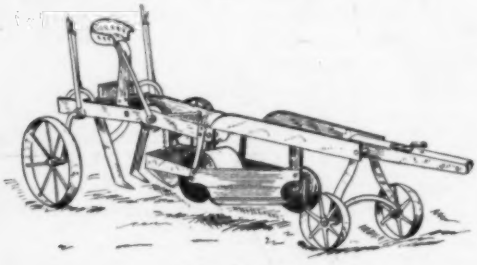
The King of Beasts Powerless

The moving of these ferocious beasts from railroad cars to dens would be a dangerous and difficult job were it not for the use of what is known as a "carrying cage," and also the skill of the workmen. This carrying cage is so built that the lion, if he be a large one, once inside has no room to move either forward or back. The sides are of heavy planks which are reinforced with iron. The front is barred and the door at the rear is made simply of strong timbers. The cage is carried by means of cleats or handles along each side.

When a lion is to be transferred from his traveling den to the carrying cage, the two cages are placed end to end and then the doors are opened. In the front end of the carrying cage a piece of meat is placed, whereupon the lion leaps wildly toward it. As soon as he has passed the threshold the door of the carrying cage is closed behind him and he finds himself unable to back up, go ahead or turn around. Several men sit on top of the cage as the lion makes the leap forward. This keeps the cage from tipping over. For a very large lion it is sometimes necessary to employ a half dozen men in carrying the cage.

NEW SUGAR BEET HARVESTER

A new beet harvester which saves from $5 to $12 per acre over the old way of gathering sugar beets is now on the market. It consists of a knife something like a plow-



Beet Digger

share, which cuts off most of the foliage. This is followed by a roller which carries a topping knife, and conforms closely to the unevenness of the ground, and cuts off the stems close to the beet. The diggers which in turn follow remove the beets and throw them out upon the ground. These several operations are all performed by the one machine drawn by a team of horses at an ordinary walk.

GREAT LAKES SHIPYARDS BUSY

All the large ship building yards on the great lakes are full of work and their capacity engaged for eighteen months to come. Sixteen mammoth vessels are under contract besides many smaller craft.

THE FIRST SUBMARINE

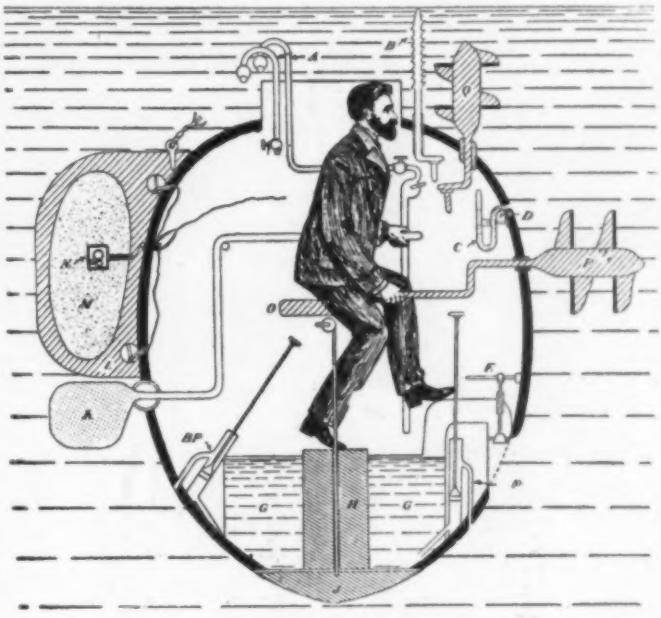
Invented by an American 100 Years Ago--Called the "Plunging Boat" and Declared Impossible

A full century ago an ingenious American, Bushnell by name, conceived the idea of a submarine boat. Instead of the modern firing torpedo he planned to bore a hole in the wooden bottom of a vessel and so attach a charge of powder which was to be fired by means of a clockwork mechanism.

Bushnell's "plunging boat" bears little resemblance in shape to the submarine of today, but did embody all its main conditions. It was egg-shaped, resembling two large tortoise shells joined at the edges.

Propulsion was secured by means of two crude propellers worked by hand, intended to give either a vertical or horizontal movement to the boat. The "torpedo" consisted of a magazine of 150 lbs. of powder to be exploded when the clockwork reached a certain point. This exploding machine had to be set going before the boat started on its errand, hence the obvious necessity of the operator losing no time in placing it in position and making his escape. A trial was actually made in New York harbor in 1776, but Bushnell experienced the same difficulty his more modern successors have found—that of finding the enemy after his boat was submerged. While he was still searching, the clock ran down and the magazine went up, but strange to relate he escaped. The boat had a lead ballast which could be released when the operator desired to come quickly to the surface. Water ballast was employed, with a hand force pump for ejecting it when desired.

In 1800 Fulton, also an American, built a submarine in France, with money furnished by Napoleon, which, although declared a success, was not actually used in warfare. Not until 100 years after the efforts of these two daring inventors did the hornet of the deep become a recognized means of warfare.



SECTION OF BUSHNELL'S SUBMARINE.

A. *Air pipes.*
B. *Wood screw.*
C. *Pressure gauge, indicating depth of submarine below surface of sea.*
D. *Compass.*
E. *Valve for introducing water into tanks.*
F.P. *Force pump for removing water from tanks.*
B.P. *Bilge force pump for ejecting leakage water.*
G. *Water tanks for adjusting buoyancy of vessel.*
H. *Lead ballasting weight.*
J. *Detachable lead weight.*
K. *Steering rudder.*
L. *Magazine.*
M. *150 lbs. percussion powder.*
N. *Clockwork for exploding powder.*
O. *Strut.*
P. *Propeller for horizontal propulsion.*
Q. *Propeller for vertical propulsion.*

CLEANING THE GOVERNMENT MINT

Last year $21,240 worth of gold dust was scraped from the nineteen chimneys of the United States mint during the annual cleaning. During the year $50,000 of gold and silver dust were swept from the floors of the mint, while thousands of dollars were recovered by burning the work clothes of employes. The mint cleaning for this year is now in progress, every precaution being taken against loss of any of the dust.

JAPANESE BATTLESHIP "KATORI" LAUNCHED

The "Katori," the first of the two big first-class battleships now under construction in England for the Japanese navy was recently launched and in a few months will be ready to help uphold the dignity of Japan upon the high seas. The vessel was launched according to Japanese custom and was christened by a member of Japan's royalty—Princess Arisugawa. Instead of breaking a bottle of wine over the stem, when the vessel was released a cage of red and white cloth hung over the stem was opened and out fluttered a flock of pigeons and a shower of confetti—a Japanese ritual to their war god Kashima.

The New Japanese Battleship "Katori"

The "Katori" had the heaviest launching weight, 9,400 tons, of any vessel ever put into the water. When completed she will have a displacement of 15,950 tons. Her dimensions are: Length between perpendiculars, 420 ft.; beam, 78 ft.; draught, 20 ft. She is designed for a speed of 18½ knots. Her armament will comprise four 12-in. guns, four 10-in. guns, twelve 6-in. guns, twelve 12½ pounders, three 3 pounders, six Maxims and five 18-in. submerged torpedo tubes. Her total ordnance is capable of discharging 24,800 pounds of shot per minute. The total coal capacity of the "Katori" is 2,100 tons. Her engines will develop 16,000 hp. There are 20 Niclausse watertube boilers in three separate rooms. The heating surface is 44,000 sq. ft.; grate area, 1,334 sq. ft. The vessel will carry 980 officers and men.

TIME-RECORDING CAMERA FOR TRAPPING MOTORISTS

A time-recording camera has been patented in England with which it is proposed to trap motorists who exceed the speed limit. The camera will take a photograph of any rapidly passing object and at the same instant photographs a watch also. The watch is in a special case which has an opening for inserting a card bearing the date.

To trap motorists, the over-speedy car is photographed by an officer with a time-camera at each end of a pre-determined stretch of boulevard and on the difference in the recorded time and the distance traversed the speed is determined, while the occupants of the car may be identified by photograph, also.

Each watch has a registered number, and is sealed in its case, making a trustworthy record for court use.

FOOD DEPOTS ON DESERT ISLANDS

The New Zealand government has provided for castaway crews by establishing depots where food and clothing may be obtained on several islands off the coast. Not long ago a French crew, shipwrecked and cast upon the Auckland islands, were sustained for a considerable period by this thoughtful provision. At most of the islands a boat is left, also, while finger posts point out the way to the depots. The government steamer visits most of the islands twice a year, and no island is visited less than once a year.

The policemen of Chicago have discovered a new method of dealing with auto scorchers. A bullet hole in one tire brings them to a stop every time.

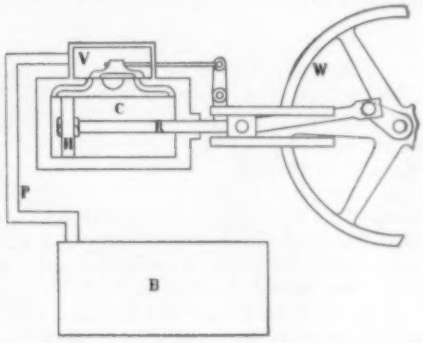
THE HARNESSING OF HEAT

PART IV.--The Steam Engine

Having now traced the evolution of heat up to the point where it has imparted its energy to a mass of water, changing the latter into steam, it remains for us to see how this energy is made to do useful work. That a mass of heated steam is capable of doing work is shown by the fact that it exerts a pressure, tending to move the confining walls of the boiler outward. The problem before the engineer then, is to so apply this steam that the greatest amount of useful work may be accomplished, with the least amount of waste.

The accompanying diagram shows the common arrangement of boiler and engine, so familiar to every one. Let us trace the transformations of energy which take place. Underneath the boiler is the coal, with its store of energy which we wish to make use of. We burn the coal, and its stored up energy is changed to heat energy; the heat gives its energy to the water in the boiler, changing it into steam, whose energy is shown by the pressure it exerts. Conducted through the pipe P to the valve chamber V, it is led into the cylinder C, in such a way as to push the piston H, and its connected rod R, first in the one direction and then in the other, producing rotation of the wheel W. Thus our transformation from the energy in the coal to the energy of the rotating wheel is complete. But notice this—there has been no energy created at any stage of the process. All that we have done is to take the energy given us by nature, and to transform that energy as best we can into the form which we wish it to take. Note this also—that such a transformation is not a perfect one. That is, do what we will, all the heat energy will not be transformed into mechanical energy. Not that any energy can ever be destroyed, but that some of the heat refuses to enter into the process, and persists in escaping into surrounding space at every available point. Thus there is loss by radiation from the boiler and its settings, by radiation from the connecting pipes and from the engine itself, and last of all there is a loss in the heat generated by the friction of the engine.

One point of great importance in regard to the engine is this—that the expansion of the steam when it pushes the piston this way and that, is done at the expense of its own heat. In other words, expansion lowers its temperature, and the useful work which we get out of the steam robs it of its heat energy. Obviously then, we desire to allow a given mass of steam its fullest possible expansion in the cylinder. So, if a simple engine were used as in the figure, the cylinder ought to be very large and long. For mechanical, as well as for other reasons, this is undesirable; so instead, we use two or three or even four cylinders, sending the steam through them in succession, allowing it to expand a little in each one, instead of attempting to perform the expansion in one cylinder. But in any case, the more the steam expands, the lower its temperature,



and finally, having given up all the heat which we can extract from it, the steam is rejected through the exhaust pipe. Thus the steam serves simply as a medium for the conveyance of heat. It is not the steam, primarily, that does the work, but it is the heat that is contained in the steam.

It must not be supposed that the cylinder is filled and emptied with steam at boiler pressure, at each stroke. There would be little expansion if this were the case, and consequently only a little of our available energy would be realized. As every engineer knows, the supply of steam is cut off when the engine has made a fraction of each stroke, and during the remainder of that stroke the work performed is done by the expansion of the steam already admitted.

Theory shows that the efficiency of a steam engine depends upon two things—first, upon the temperature of the entering steam; second, upon the temperature of the exhaust steam. The higher the temperature of the former and the lower the temperature of the latter, the greater will be the efficiency. The

natural way of increasing the initial temperature is to increase the pressure, and the last fifty years has seen a steady rise in boiler pressures. The natural way of lowering the temperature of the exhaust is to allow the steam every possible chance for expansion, thus extracting every bit of heat which it is possible to extract. Taking as a fair value for the maximum safe pressure, 175 lbs. per square inch, the theoretical efficiency of a perfect steam engine is about 31 per cent, that is, only this percentage of the energy given to the engine in the form of heat would be available for useful work. Since every engine must waste a great deal of energy in friction, and since heat is constantly leaking out into the surrounding air, the practical efficiency of an engine is much less than the above figure.

HAUL RAILROAD TRAIN BY ROPES

On a grade of 1 in 42 out of the Queen Street Terminus, Glasgow, on the main line to Edinburgh, the trains are assisted by being hauled by a rope. When the line was first opened in 1842 it was considered that this incline, which is 1¼ miles long, would be too steep for ordinary locomotive power. A pair of 80 h. p. beam engines were placed at the head of the incline to work a large drum round which an endless wire rope (when first installed the rope was of hemp) went down one line, round a horizontal grooved wheel, and back up the other line. These engines have been almost continually at work since 1842. The wire ropes weigh about 24 tons and last about 15 months. They pass over grooved pulleys between the rails to keep them from rubbing on the sleepers or ballast, also to preserve their proper course.

INSTANTANEOUS X-RAY PHOTOGRAPHS

The long exposures required in X-ray photography have been a great disadvantage in its use for practical purposes. After many experiments, however, Prof. Rieder and Dr. Joseph Rosenthal of Munich have succeeded in taking instantaneous X-ray photographs. The apparatus used includes strong electric currents, especially good X-ray tubes, very sensitive photographic films and intensifying screens. Photographs of the human chest were taken in less than a second, the patient ceasing to breathe in the meantime.

Taking photographs between heart-beats was another important experiment tried. The period of exposure required was measured by a contrivance consisting of a wooden disk, 39 in. in diameter and covered with lead. A sector, one-seventh of the entire surface, was cut from the disk. The object to be photographed and the sensitive plate were placed behind the disk and the X-ray apparatus in front of it. The disk was revolved on its center once in a second, and the open place in it exposed the plate to the rays just one-seventh of that period.

Wire Cable Hauls Railroad Train

THE AMERICAN DIESEL ENGINE

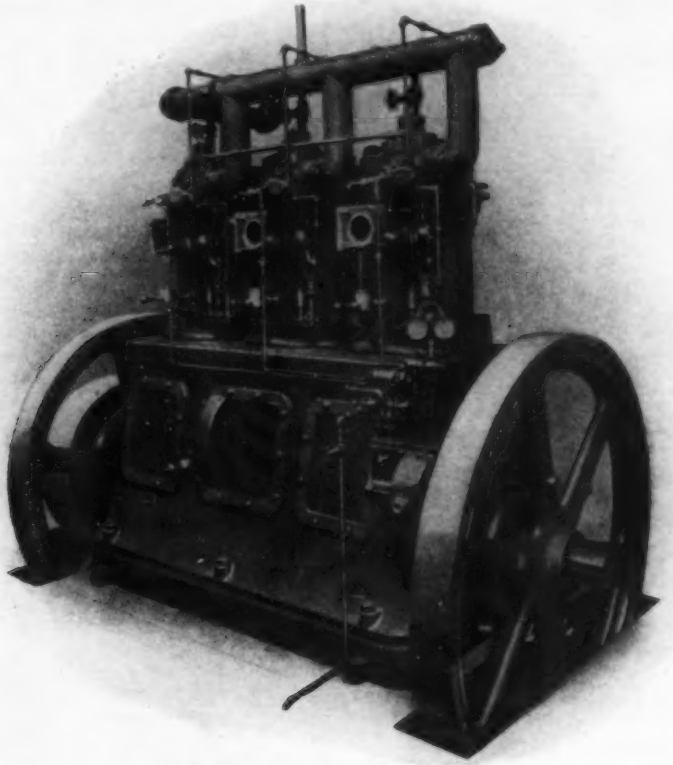
By Geo. W. Richardson, Consulting Engineer, Chicago

Forty years marks an important "epoch" in most men's lives. To the man of reflective mind, who reaches this age, life takes on new aspects. Thenceforward the future grows more and more uncertain. The longer part of life's road now lies behind, and the man gradually comes to realize, whether he likes to acknowledge it or not, that he is to some extent at least on the down grade. Naturally the past becomes more and more the subject of his thoughts, and he finds pleasure in recalling and recounting the deeds of the years gone by.

Something of this pleasure of retrospection has been mine in preparing, in response to the invitation of the editor of this magazine, a description of the American Diesel engine and a statement of the remarkable economy achieved by it.

Before describing this engine it is best to give a brief outline of what has been accomplished in the past with the steam engine as a prime mover.

Prior to 1848 the leading prime mover was the simple slide valve throttling governor steam engine. This engine was very uneconomical due to the fact that the steam in the cylinder was not cut off until three-fourths of its stroke was passed, thereby losing the benefits of the expansion of the steam after cut-off.



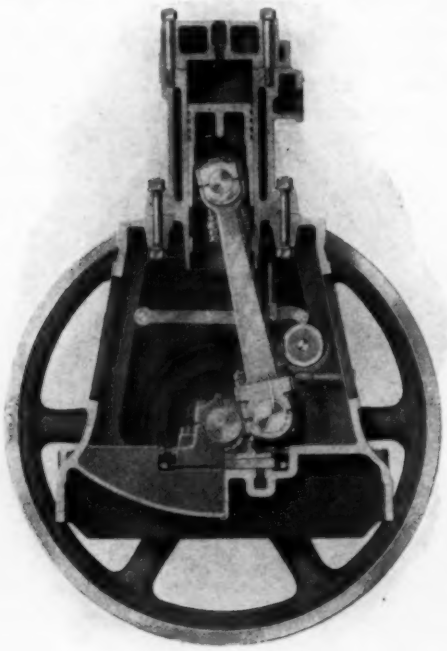
Triple Cylinder--225 H. P.

Later this loss was reduced by cutting off the steam earlier in the stroke, say at ¼th, thus allowing ¾ths of the remaining stroke for the steam to expand. Below is a table showing the effective pressures at different points of cut-off:

Steam cut-off at full stroke			equals	100 lbs	effective pressure	
"	"	⅞	"	90	"	"
"	"	⅘	"	80	"	"
"	"	⅝	"	62½	"	"
"	"	½	"	50	"	"
"	"	⅖	"	40	"	"

From the above it is evident that if you

only get 100 lb. effective pressure with a full cylinder of steam, and you get 40 lb. effective pressure with only ¼th of a cylinder full of steam the quarter cut-off is by far the most economical to use. It was Geo. H. Corliss who first brought out this automatic cut-off gear.



Sectional View Diesel Engine

But, as was the case with the Diesel engines, Corliss had a hard time to introduce his engines as the public was then, as now, skeptical about adopting new and modern methods. In his effort to secure business and introduce his engines Mr. Corliss, in the early days, resorted to the making of unusual guarantees, often agreeing to take as the price of the engine, the saving of the fuel in a specified time.

In 1852 Corliss put a new engine in the rolling mill of Crocker Brothers & Co., in Taunton, Mass., guaranteeing to do one-third more work than the old engine was doing, and where five tons of coal had been used per day but two tons should be used to do the same work; and further guaranteed to forfeit $1 per pound for every pound per day used in excess of the two tons.

Since then there have been numerous engines on the market, notably the shaft governor type of automatic cut-off gear, claiming the same economy and in some cases higher, and most recently the steam turbine; but they all want to guarantee the steam per horsepower per hour. None of them will guarantee the cost of the fuel to make this steam.

Now at this late date comes the Diesel engine showing as remarkable an economy over the Corliss engine as the Corliss engine showed over the old throttling governor; and with the equivalent guarantee, viz.:

This engine being an oil engine, or what is known as the internal combustion engine, it is possible to guarantee the cost of fuel.

It is guaranteed that the cost of, or the saving made in the fire room of a steam plant, i. e., fireman's wages, and labor of handling coal, repairs to boilers, setting and grate bar repairs, etc., will pay for the oil this engine will consume. So the saving in operation, as compared with the steam plant, would equal the total value of the coal the steam plant would have consumed.

In describing this engine it may be well to state that there is no other engine in the world that works on the same principle. Its cycle is the same as the gas engine, such as the well known Otto cycle. There its similarity to the gas engine ends absolutely; in everything else it follows the lines of the steam engine.

The first stroke is a suction stroke, drawing in a cylinder full of pure, clean air; on the second stroke it compresses this to a tension and consequent temperature sufficient to ignite any fuel which may be injected into it; therefore no igniters are neccessary, doing away with this evil. At the beginning of the third stroke, a small quantity of fuel oil is injected into this red hot air in the form of spray, by means of a jet of highly compressed air, and thus in a completely atomized state the fuel meets and mixes with the hot compressed air in the cylinder, burning (due to the pure air) to complete combustion, and during a period of time exactly regulated by the governing mechanism of the engine, generally through 1-10 part of the stroke; subsequent to which the stroke is finished by the expansion of the burnt products. The fourth stroke discharges the products of combustion, and leaves the cylinder empty and ready for another suction stroke.

It should be borne in mind that the air in the cylinder at the commencement of the working stroke is more than sufficient to burn all the fuel that can be introduced while the fuel valve is open, and as it is at extremely high temperature, and the oil is injected in a finely divided condition, complete and perfect combustion is the result.

A great many people think that the power expended to compress this air is lost, which is not true, for if you drop a rubber ball on the floor it will rebound, so it is evident that the power expended in compressing the cylinder volume of pure air is given off again to the shaft of the engine during the combustion or motor stroke.

This simple process, absolutely new and original with Diesel, has enabled him to accomplish with one-half pint of common crude or fuel oil as much as the explosive engine does with a full pint of the much more expensive gasoline. There are no explosions in the cylinder of this engine, as in a gas or gasoline engine; instead the oil burns gradually to complete combustion. A white handkerchief held over the exhaust of this engine will not become soiled.

It may be well to state that the oil, called fuel oil, is a by-product of the oil refineries. That is, it is the refuse after the kerosene, naphtha and gasoline have been extracted, and as this engine will burn any kind of oil, and all oils have the same caloric value, the cheapest is the best for the purpose intended. Fuel oil is generally sold at from 3 to 4 cents per gallon.

The Diesel people guarantee 100 horsepower for one hour, under your own operating conditions, with not to exceed 8 gallons of oil, or 150 horsepower hours, which is equivalent to 100 kilowatts on the switchboard, on 12½ gallons of oil; and will pay for all oil used in excess of this. In actual practice this amount is reduced 25 per cent. Consequently with this large margin of 25 per cent they would be safe in paying $1 per gallon for all oil or fuel one can burn in excess of their guarantee.

The reason that this engine is able to show such a high economy is due to the fact that its heat efficiency is 40 per cent of the fuel expended and works on the cheapest grades of fuel oil.

While the Corliss engine is the best type of steam engine it only utilizes 6 per cent of the fuel expended. Below is a table of the efficiencies of the different types of (prime movers) engines:

	Per cent.
A good slide valve steam engine utilizes only	5
A plain Corliss engine utilizes only	6
A compound condensing engine utilizes only	8
A reheating compound or triple expansion or turbine utilizes only	12
The best oil engine (explosive type), utilizes only	16
The best gas engine (explosion type) utilizes only	15
The Diesel Engine oil (non-explosive), utilizes fully	40

For New York or Chicago conditions, with coal at $3 per ton, and fuel oil at 4 cents per gallon delivered, 100 actual horsepower hours cost only 36 cents for fuel in a Diesel engine as against 60 cents in a large Corliss engine; or $1.10 in the slide valve engine generally used in small plants.

The following table shows the saving in

PRICE COAL PER TON.

OIL AT	$2.00	$2.25	$2.50	$2.75	$3.00	$3.50
3 cents	$12.16	$14.69	$17.22	$19.76	$22.30	$27.35
3½ "	10.81	13.34	15.87	18.41	20.95	26.00
4 "	9.46	11.99	14.52	17.06	19.60	24.65
4½ "	8.11	10.64	13.17	15.71	18.25	23.30
5 "	6.76	9.29	11.82	14.46	16.90	21.95
5½ "	5.41	7.94	10.47	13.11	15.55	20.60
6 "	4.06	6.59	9.12	11.76	14.20	19.25
6½ "	2.71	5.24	7.77	10.41	12.85	17.90

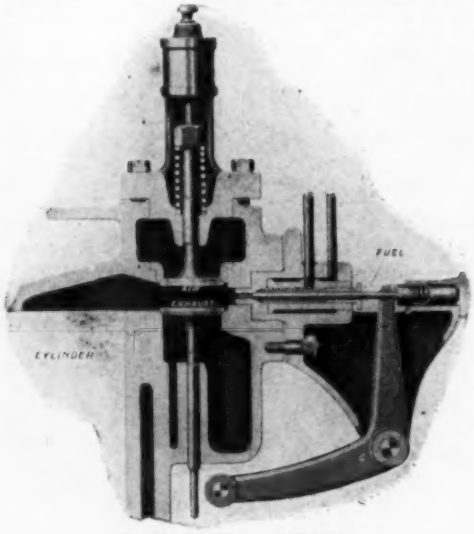
Diesel engine over slide valve engine, for each B. H. P. 3,000 hours per year, 50 H. P. to 100 H. P.

The fuel consumption in the Diesel engine is proportional to the load. Therefore, on variable load from half to full power add 50 per cent to the above saving. No fireman needed.

It will interest some readers to compare the relative features as to space occupied, weight and attendance required by the steam and Diesel engines respectively. For illustration take a 100-hp. plain horizontal Corliss engine. Such an engine will occupy about 5 ft. by 25 ft. of floor space, to which must be added floor space for flywheel and in the boiler room for boilers, feed water heaters, and pumps of not less than 16 ft. by 40 ft. or a total of 765 sq. ft. A Diesel engine of 100 hp. occupies 5 ft. by 12 ft. or a total area of 60 sq. ft. There are the further economies of stack, piping, valves, etc., which are inevitable in the use of a steam engine.

A natural query to make is one regarding the method of starting this engine. This is

done by compressed air from the auxiliary reservoir. A handle (not shown) throws the fork (see illustration) so as to move the valve cams of the first cylinder along the



Sectional View of Valves

cam shaft, and brings into operation a starting cam operating a starting valve. This valve simply admits compressed air to drive the piston for one or two revolutions and the compression is then sufficient in the other cylinders to ignite the charge in these cylinders. The starting cam is automatically thrown out of action and the admission and exhaust cams thrown in when the handle is let go.

FIRE ALARM BOX THAT HANDCUFFS TRICKSTERS

When the new fire alarm box recently patented is installed, fire companies will no longer be called out by false alarms—or, if they are, the miscreant will receive his due. The box has a small door in front, and immediately this is opened a large gong in the box begins sounding, attracting attention to that place. On the inside are two small doors, having a slot through which the hand must be thrust to send in an alarm. As the party sounds the alarm a rubber-lined aluminum handcuff snaps around his wrist, the slotted doors fly open, releasing the handcuff and three feet of chain, and the party is a prisoner until the fire company arrives to find out where the fire is and release him. He can, however, close the large doors of the box and cause the large gong to cease ringing.

WHY MOTOR BUSES WILL NOT DISPLACE STREET CARS

Motor buses are coming into common use in European cities, and to a limited extent in this country, but are not calculated to replace street cars, at least until several economies can be effected.

The cost for power is less per passenger in the case of the street car, as metal wheels on steel rails cause less resistance than rubber tires on even the best pavement. The cost of the rubber tires is another reason, as records show the expense for tires to be about 4 cents per mile, against 2½ cents per car for rails. The power cost is 24 cents per ton for electric cars and 80 cents for gasoline.

TIN PRODUCTION IN 1904

The world's production of tin in 1904 was 92,243 tons, of which 159 tons was mined in the United States. This country imported 40,382 tons, valued at $21,486,311. The world's consumption exceeded the production by 2,512 tons.

PARIS MOTOR BUS

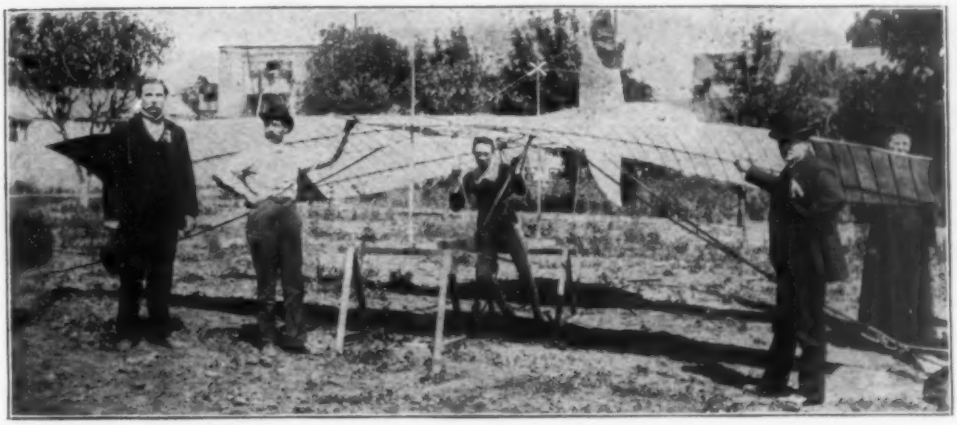
The pavements of Paris are unusually good, being chiefly asphalt. The conditions therefore for vehicle travel are excellent. The extensive omnibus system by means of

Bus Used in Paris

which the citizens largely travel is to be changed from animal to motive power. The illustration shows the bus which has been adopted, gasoline engines, air cooled, being used.

FATAL ACCIDENT WITH AEROPLANE

Aeronaut Maloney Falls 2,200 Feet--Did Not Know Mast Had Broken--Experimental Flights With Machine To Continue



White Cross Shows Where Mast Was Broken--Aeronaut Maloney in Saddle--Prof. Montgomery, the Inventor, at the Right

The promising experiments at Santa Clara College, California, illustrated in July, and which attracted world-wide attention, are temporarily delayed through the fatal accident to the daring operator, John Maloney.

The aeroplane has no direct means of ascent or propulsion as yet, and a balloon has been used to tow it up. When the ascent was made one of the ropes failed to release properly, and it is believed, broke one of the two masts on the aeroplane. Maloney evidently was unaware of this, or else took chances he should not have done. At a height of 2,200 ft. he cut loose from the balloon and glided downwards for over 1,200 feet. He then undertook a dive at an angle of 60 degrees through a distance of 100 ft. Ordinarily the machine could stand the necessary strain, but this time the back wings collapsed and the aeronaut lost control. Clinging to the aeroplane he fell to the ground through from 1,000 to 800 feet and died twenty minutes afterwards. The accident was witnessed by hundreds of spectators and when the aeronaut was falling and seen to be doomed, Rev. Father Bell, one of the professors and a close friend of Maloney, uncovered his head, raised his hand and administered the final blessing to the unfortunate man.

Maloney made desperate attempts all the way down to control the machine, but without success.

Prof. Kavanagh writes: "In the accompanying picture I have marked a portion of the machine called the mast. The balloonist testified, at the coroner's inquest, that when the balloon made its first leap from the earth, this mast was broken by one of the ropes that were used to liberate the balloon. A break in that part of the aeroplane would not be dangerous in slight dips and curves. It would, however, account for the mishap after the deep plunge mentioned above, for at the sudden turn there would be more pressure above than below the wing surface and the back wings which, on account of the break, were free to move down, would naturally sink in and cause a backward somersault, which was in fact observed.

"Several aeronauts have already applied for leave to operate the machine, one of them after having witnessed the disaster. They seem to attribute the accident to excessive boldness on the part of Mr. Maloney, and in all truth he was extremely bold."

A new type of milk car used on the Great Northern Railroad of England is fitted with a special adjustable ventilating apparatus. The milk is no longer nearly churned into butter by the oscillation. Even on sharp curves at rapid speed the oscillation is scarcely noticeable. The milk vans are 45 ft. long.

THE MANUFACTURE OF CEMENT POSTS

By H. A. Low, in Concrete.

The growing scarcity of suitable timber for posts, and the increasing cost, have caused a strong demand for a substitute which will at the same time be cheaper and durable. To meet this urgent demand engineers and inventors have brought forward steel posts, cast iron posts, cut stone posts and finally concrete or artificial stone posts. These latter have been tried and not found wanting. The principal materials for their manufacture, sand or gravel and cement, are easily obtainable in every locality, and what is a determining factor, are remarkably cheap. The third element necessary in the manufacture is a steel reinforcement.

After all experiments and ventures have been tried, it is now a known fact that the best and cheapest reinforcement is steel wire, cabled tightly. This great value of steel wire reinforcement is obtained from the well-known principle and scientific fact that steel in tension and concrete in compression are the best materials used in their strongest way. The reinforcement being decided upon, the next step is the position of this and the method of making the post.

The best place to have the reinforcement is in the corners of the post, because the greatest strength is obtained by so placing, and the nearer to the edge they can be placed, without danger of the concrete breaking out under the strain, the better. I have found that in an ordinary line post the wires should be placed within a half inch of the edges. By placing the reinforcement in each corner of the post, two wires in tension are always secured no matter from what direction the strain comes.

The next consideration is the method or process of making the concrete. I have found that the tamped or dry process has not been as successful in tests as the wet process product. The latter uses less cement, makes a denser post and gives the cement enough water to make nearly perfect crystallization, at the time when it needs it, and not after the initial set has taken place. The tamped post is more subject to the action of the elements, and water penetrating it readily makes it liable to injury from the frost. The wet process post has a glaze on the surface that makes it nearly impervious. Furthermore, there can be no accurate placing of the reinforcing wires with the tamped post, for the reason that the tamper will displace the wire, and the concrete will not form around and unite with the wire, sinking into the shoulder of the twist and not allowing the wire to stretch as it will when wet enough to pour. All in all, I believe that the most successful way to make a fence post is to pour it.

After posts have been molded and the concrete has set, they are ready for the curing, which should be done in the manner of other concrete products, keeping them well sprinkled. The posts can be used in thirty or even twenty days after they are made, but it is advisable to keep them at least sixty days previous to setting out.

The posts, being made of true concrete, grow constantly harder and better by exposure to the weather. I have observed posts that have been allowed to freeze in a river and thaw out that were apparently stronger than before. The farmers of today are alive to every meritorious article. They read their farm journals carefully, and they are aware of the fact that there are some posts better than wooden ones. They have the money to invest in a post that offers durability and they are willing to invest it. The field for making the posts is unlimited and the demands are immense. To fence the United States farm lands, properly, would require the enormous number of over three and one half billions of fence posts. The possibilities of the business are simply enormous. The consumption of fence posts in this country today touches so high a figure as to stagger the mind. A conservative estimate shows that the number of posts in use at the present time in the United States is 3,446,345,528. The field is an especially alluring one and is sure to bring financial success to the progressive business man who enters it promptly.

A speed of 130 miles an hour is declared by a French automobile engineer to be the maximum attainment possible to automobiles, while maintained at the present weight. M. Serpollet has determined to approach this limit as nearly as possible, and is now building a machine designed for a speed of 125 miles per hour. The weight of the engine, without steam generator or boiler, will be 330 lbs. and the motor will develop over 200 hp.

All the articles appearing in this department are reprinted in book form at the end of each year.

SHOP NOTES

Contributions to this department are invited. If you have worked out a good idea or know of one, please send it in.

CHEAP PAINT FOR ROUGH WALL SIGNS

A solution consisting of green vitriol stirred into lime milk makes an excellent cheap yellow coating for large signs on rough dead walls, rocks, cliffs, etc., says the Master Painter. The paste will be green at first from the separating protoxide of iron, but after it is applied and dry will become yellow by oxidation in the air. It adheres firmly to any surface and will not wash off. The color is darker or lighter, according to the amount of green vitriol used.

HOW TO FASTEN A RING TO A ROPE

The writer has used the method shown in the accompanying drawing in fastening a halter rope to the ring of the halter, but it is apparent that the method applies to any similar case where ropes and rings are used.

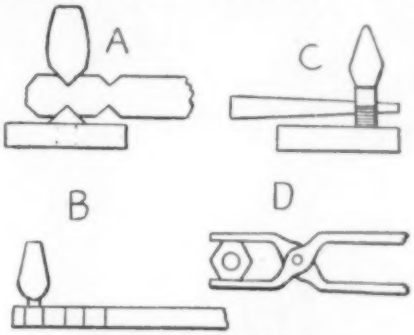
The advantage is that the ring has two thicknesses of rope to wear through before a break can occur. The free end of the rope is fastened down to the other with a cord or wire. If heavy wire must be used, it may be wrapped as tightly as possible and then hammered flat.—Contributed by Joseph B. Kell, Marion, Ohio.

PIERCING PUNCH OF PIANO WIRE

Piano wire makes an excellent piercing punch for piercing holes in sheet metal, says a correspondent of the American Machinist. The punch is rather difficult to make, but is good for piercing holes of the same diameter as the thickness of the metal, or when the metal is unusually tough.

HOW TO MAKE SIX-SIDED NUTS

Good iron will be required for this purpose as poor iron will not stand the thread cutting. Take a piece the size the nut is to be and cut the nut. Do not cut from the

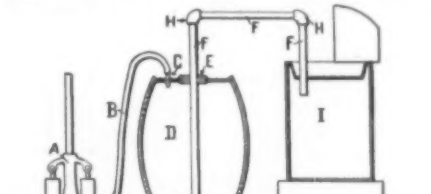


Making a Six-Sided Nut

flat side, says the American Blacksmith, but hold the iron on the hardy as shown in the illustration at A. B shows the punching operation, C finishing the shape and D shows a pair of tongs for holding the nut, which must be made thinner, as ¼ in. is a little too thick. Finish the nut on a pin from 16 to 18 in. long.

EMPTYING AN OIL-BARREL

The illustration shows a method of emptying oil from the barrel that will do the



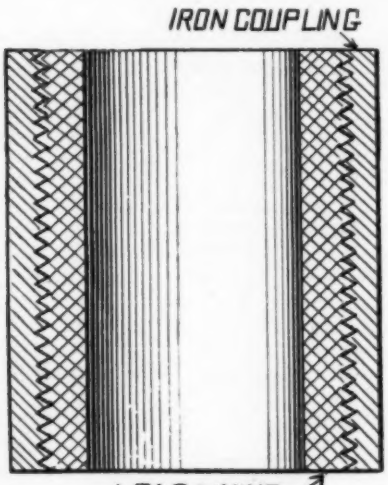
Emptying An Oil Barrel

work in from ten to fifteen minutes. The apparatus includes the following parts:

A, pump (any old pump will do); B, hose; C, bush on hose; D, oil barrel; E, large bushing; F, ¾-in. pipe; H, ¾-in. elbow; I, oil tank. The oil is forced out by air.—Contributed by Alex Mattley, Menominee, Wis.

PIPE CLAMP THAT WILL NOT CRUSH OR MAR PIPE

Having occasion to do some pipe fitting with brass and nickel pipe I made use of the following kink to hold same in an ordinary pipe vise, the object being to grip the pipe



Safe Pipe Clamp

tightly, but not mar or scratch or even crush it, as an ordinary pipe vise would:

The clamp is made of a common iron coupling one size larger than the pipe to be held, i. e., for ¾-in. pipe use a 1-in. coupling. Slip the coupling over the short piece of pipe, and using the pipe as a mandrel, pour melted lead around it, filling up the coupling. When cool, slip the coupling off the pipe and saw it in halves, using a back saw. You will now have a clamp made of two halves, one of which is shown in the illustration. When using sprinkle the clamp with plaster of paris and you will get a never-slip grip. The threads of the coupling are all that is required to hold the lining. It is cheaper to make a whole set of these clamps than it is to buy a special machine.—Contributed by John Weldon, 433 Columbia St., Brooklyn, N. Y.

SIZE FOR PLASTER WALL

Boil flaxseed in water and apply to the wall, or it may be applied over a first coating of paint. This size is useful on wood, also.

HOW TO ESTIMATE WEIGHT OF WROUGHT IRON AND OTHER METAL BARS

The weight of a bar of iron, steel, copper, lead or brass may be very quickly and quite accurately estimated by the following formula. Multiply the dimensions and add one cipher to the result. Then divide by 3 and the final result is the weight in pounds.

For example: Take a bar of wrought iron 20 ft. long by 2 in. thick by 4 in. wide, and we have 20x2x4=160. Add a cipher, which gives 1,600 and this divided by 3 gives 533⅓, which is the weight in pounds.

For cast iron deduct $\frac{1}{36}$ from the weight of wrought iron.

For steel add 1-48 to the weight of wrought iron.

For copper add 1-7 to the weight of wrought iron.

For lead add ½ to the weight of wrought iron.

For brass add ⅛ to the weight of wrought iron.

Contributed by Anthony Haselman, Newark, N. J.

A HOOK KINK

Fig. 1 shows a common hook whose bad feature is that when hoisting, point A catches on any projection it may encounter. If the eye is turned around as shown in the side view, Fig. 2, point B will strike a projection

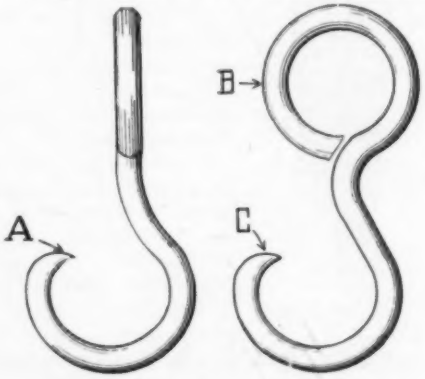


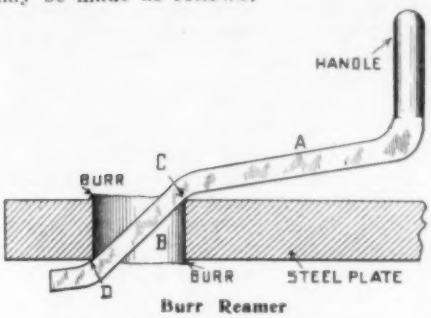
Fig. 1 Fig. 2

first. This will cause the hook to bounce off and point C will safely pass by the projection.—Contributed by John Weldon, 433 Columbia St. Brooklyn, N. Y.

A gill of shellac varnish added to a gallon of asphaltum is a good hardening agent.

HANDY BURR REAMER

When rolled steel plates have been drilled, especially ones 1½ in. or more in thickness, they have a burr around the upper and lower edge of the hole. A reamer that will quickly cut these off and save a lot of chiseling may be made as follows:



Burr Reamer

Have the blacksmith bend a piece of ½-in. square tool steel, about 15 in. long, to the shape shown in the illustration at A. Temper this device, grind it square and sharpen at the points C and D, where it is to cut the burrs. Place this reamer in the drilled hole (B in the sketch) and turn it round and round a few times until it has cut the top and bottom edges of the hole smooth.—Contributed by W. J. Slattery, Emsworth, Pa.

DRESSING OIL OR WHETSTONES

When it is necessary to dress oil or whetstones, level them on the emery wheel, holding them on the flat face. This requires from three to five minutes and makes them like new stones.—Contributed by J. W. Brown, Rensselaer, Ind.

ADVANTAGES OF ZINC ROOFING

The advantages of zinc roofing over other roofing materials is receiving more or less attention in this country of late. The claims for the superiority of zinc for this purpose is based on its tenacity, its density, its durability, the fact that it is not inflammable and that a thin coating of oxide forms upon the zinc when exposed, this coating being insoluble in water and becoming a permanent protection, preventing further corrosion and doing away with the necessity of painting the roof.

Zinc is one and one-half times lighter and four times stronger than the same substance of lead. Old zinc when stripped from a roof is said to be worth one-half its original value.

The largest zinc sheets used for roofing are 8x3 ft. in size, 0.053 in. thick, and weigh 1 lb. 14 oz. per square ft. The roof must be laid so as to give the material plenty of play, as the expansion and contraction of zinc is greater than that of any other metal. Under extremely high temperatures zinc gives off a bright green flame, which fact has given rise to the belief that it is inflammable.

CONVENIENT CENTER GAUGE

The sketch shows a method I have found very convenient, and which will be understood from the drawing, for truing or lining

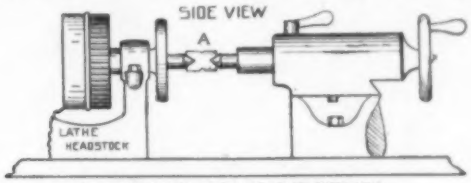


Fig. 1 SHOWING GAUGE ON LATHE CENTERS AT A.

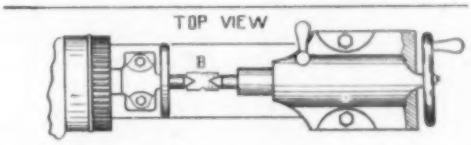


Fig. 2 WITH GAUGE ON CENTERS AT B.

up the centers in an iron turning lathe. By taking a piece of sheet steel 3/64 in. in thickness any skilled machinist can make one in a short time. This device can be used for thread tool centering as well as lathe centers at 60 deg., graduated pitch. This gauge

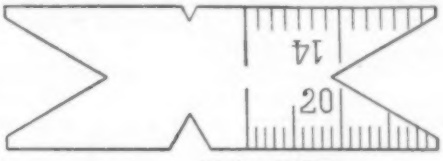


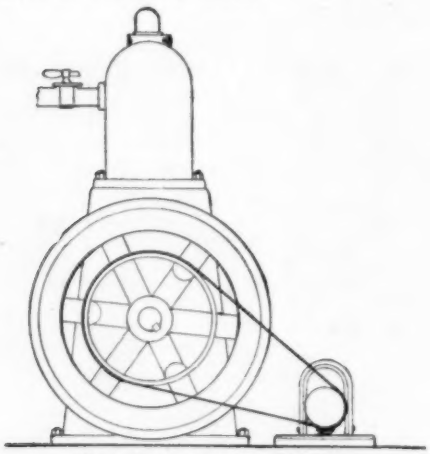
Fig. 3 FULL SIZE

can be graduated the same as any other center gauge; on one side 14ths and 20ths, and on the other 24ths and 32nds in fractions of an inch.—Contributed by F. M. D., Rock Falls, Illinois.

Rubbing a window pane with fine sand and water will make it obscure, yet diaphanous, says the Master Painter. Another method is to cleanse the glass thoroughly, then moisten it with hydro-fluoric acid. When the acid has eaten the glass enough, wash it off with plenty of clean water.

FIRING A GAS ENGINE WITH A TELEPHONE MAGNETO

The magneto out of an old broken telephone can easily be used instead of batteries, for running a gas engine. The batteries are usually a source of trouble, especially if the engine is used very much.



Magneto Connected to Engine

To connect the magneto, saw out a pulley a little narrower than the large cogwheel on the machine and ¼ in. thick. Then screw off the handle and bore a hole in the center of the pulley large enough to fit the screw from which the handle was taken. Now screw on the pulley and you will find it will hold very securely. Fasten the magneto to a block of wood and nail the block to the floor. Take an ordinary sewing machine belt and connect it around the main pulley on the engine, and a V-groove on the wooden one of the magneto.

To make connections take the two wires from the magneto and join them to a spark coil and from there to the engine.—Contributed by E. H. Klipstein, 116 Prospect St., East Orange, N. J.

SOLDER FOR ALUMINUM

What is reported to be the most successful solder for aluminum yet secured, consists of tin 64 parts by weight, zinc 30 parts, lead 1 part and aluminum 1 part, to which add a small portion of resin. To solder, clean the surfaces and face with the solder. No chemical is used, but the surfaces of the parts to be soldered should be gently heated to assist in making a good adhesion.

USE OF THE COMPASS IN LOCATING POLES OF A GENERATOR

Numerous letters have reached us asking if the following statement, which recently appeared in this magazine is not a mistake. The statement was:

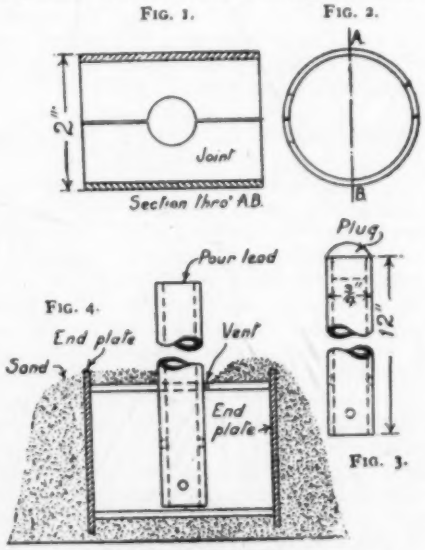
"While the dynamo is in service, bring the north-seeker end of a compass needle near each of the poles. Those that attract this end are north poles and those repelling it are south poles."

What has misled is the common mistake of calling the north-seeking end of the compass needle a "north pole." In reality that end of a compass needle is the south pole of the compass; otherwise it would not seek the north magnetic pole of the earth, because like poles repel. Hence when a compass is brought within the influence of a generator that is the north or positive pole of the generator which attracts the north-pointing end of the compass needle.

HOW TO MAKE A LEAD HAMMER

Lead hammers are useful when assembling parts which it is important not to mar. Such a hammer can be made in the shop, says a correspondent of the Model Engineer, London.

In the center of a piece of 2-in. tube, 3 or 4 in. long, drill a ¾-in. hole and then, cutting through the center of this hole, saw the tube in two. Through a foot-length of ¾-in. tube, drill two ⅝-in. holes at right angles to



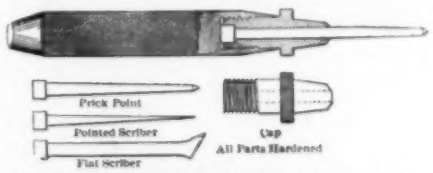
Details of Lead Hammer

each other, one ¾ in. from one end of the tube and the other 1½ in. from the same end. This last tube is for the handle.

Procure some ordinary moulder's sand and bed the two halves of the large tube in it, so that the sand holds the two parts together. Into the ¾-in. hole in the large tube insert that end of the handle tube that has the two holes. Against each end of the 2-in. tube, place a piece of tin to keep the molten lead from running out. Bank up the tube and ends well with sand, leaving a vent hole on top for air to escape. Pour molten lead down the inside of the handle until the large tube is full. When cold remove the halves of the large tube and the lead head will be secured to the handle by the two ⅜-in. holes in the handle. Fig. 1 is a sectional view of the 2-in. tube; Fig. 2 is an end view of the same; Fig. 3 shows the handle, and Fig. 4 shows mould with handle, ready for casting. File around the edges of the outer end of the handle.

INTERCHANGEABLE SCRIBER POINTS FOR PRICK PUNCHES

The prick-punch shown in the illustration is made so that a number of interchangeable scriber points may be substituted as required. This is a handy tool for the portable kit of a traveling mechanic. Its principal advantage, says a correspondent of Machinery, is that the point can be kept sharp easily, since the cross-section does not increase in size much up to the holder. A



Prick Punch With Interchangeable Points

point can be substituted for one that has been ground away without going to the tool dresser.

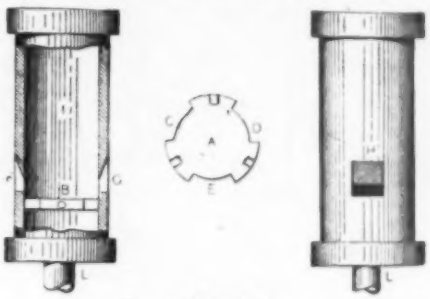
FILLING FOR CRACKS IN FLOOR

Cracks in a new floor that is to be stained and varnished may be filled with a putty made as follows. Dissolve 2 parts common glue in 14 parts water, then mix in 4 parts plaster of paris and 2 parts litharge.—Master Painter.

HOW TO MAKE A WHISTLE FOR A STEAM PLANT

In a plant where there is no whistle this convenience can be contrived out of a piece of 4-in. brass pipe 1 ft. long. A correspondent of the Engineer's Review tells how to make such a whistle.

Make a center piece, A in the sketch, out of a piece of brass and drill three holes in it.



Home-Made Whistle

File away three sides of this disk, C, D and E to provide for steam passages. Make holes in the tube to correspond to those in the disk, fit the disk in the tube as at B, Fig. 1, and run pins through the holes in the tube to those in the disk. Cut the pins off even with the outside of the pipe and solder firmly.

Above the steam passage in the disk and in line with them file three rectangular holes, F, G, in the brass pipe. On the upper side file the edges down to form a sharp lip (H, Fig. 2). Fit round disks to the top and bottom of the whistle having the lower one drilled and tapped for a steam pipe, L. This whistle makes a sound that can be heard all over the plant.

STEEL-BLUE ENAMEL FOR ANY METAL

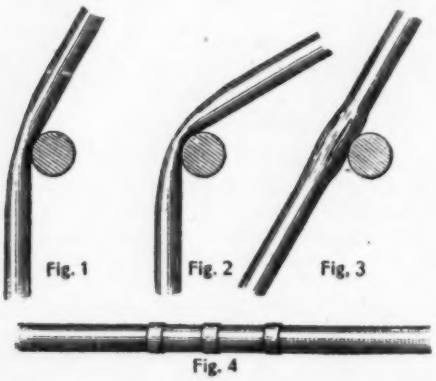
An enamel for use on any metal and which will keep so long as it is tightly corked is made as follows:

Dissolve 1 part of borax in 4 parts of water. Macerate 5 parts bleached shellac in 5 parts of alcohol, saving out a small portion of the alcohol for dissolving methylene blue of sufficient amount to give the color desired. Heat the watery solution to boiling and, constantly stirring, add the alcoholic solution. Stir out all lumps and add the blue solution. Before applying, clean the metal bright with an emery cloth. Apply enamel with a soft brush.

TOOLS AND DEVICES FOR BENDING PIPE

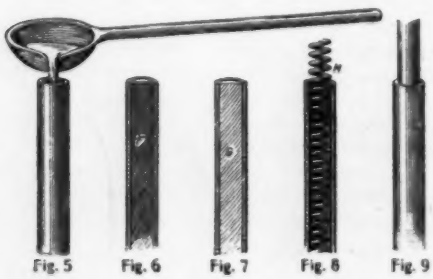
A corner fitted up with tools and devices for working with and bending pipe will be found a convenient and profitable department in many shops. Very little space would be required, and with the proper apparatus the difficult task is rendered light and easy.

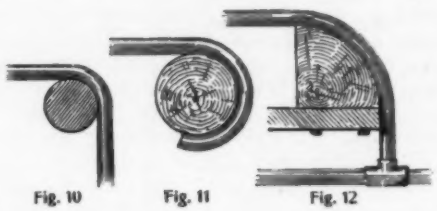
The result of trying to bend tubes or pipes with a section of steel rod is shown in Fig. 1. The tube wall is crushed in and when further doubled over is completely ruined (Fig. 2). Sometimes, where it is attempted to bend the metal back to restore the fractured place, it splits as in Fig. 3. At this point the workman probably tries to



remedy the matter by brazing on metal rings, as in Fig. 4.

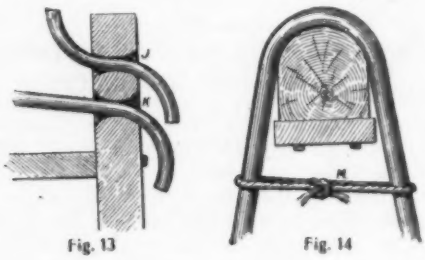
All this trouble could be avoided by melting rosin in a good-sized glue pot and then with a ladle pouring it into the hollow of the pipe or tube, as in Fig. 5. When the pipe is filled, plug the other end with a wooden stopper and you have a solid wall as at F, Fig. 6, a sectional view. Or, if preferred, or more convenient, the tube may be packed with clay, as at G. The spiral spring method is shown in Fig. 8 and a set of springs for this purpose ranging in size from ¼ in. to

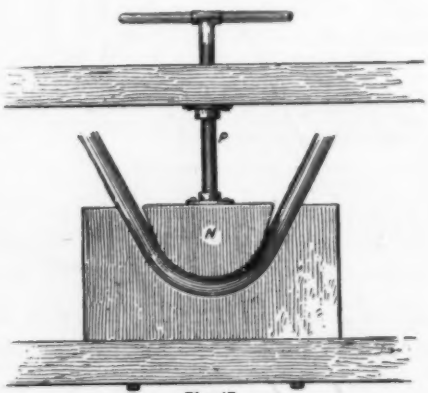




1 in. in diameter could be made from common steel wire and hung up in order in the pipe-bending corner. The method shown in Fig. 9 involves the use of a piece of wire to fit the inside of the tube. This is a good method for bending tubes of small diameter. By all these methods the pipe can be bent cold.

Pipe-bending forms are shown in Figs. 10,





11 and 12. The small round forms are metal, but others may be made of common hardwood stock. Shaft stock, 2 or 3 in. in diameter, may be used for a form like Fig. 10. Secure the shaft to a firm base of wood and effect the bending much as in bending over the point of the anvil. Hardwood is used for bends of large diameter, as in Fig. 11.

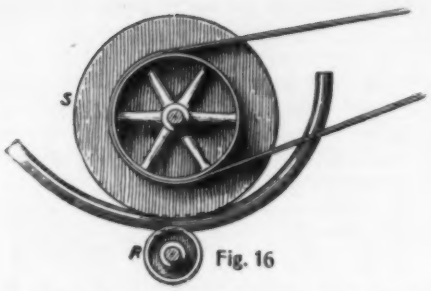


Fig. 16

The bending device shown in Fig. 13 is made of wood and is very handy. To make it select a piece of hardwood 4 in. square and 3 ft. long. Bore straight through one side, using an inch bit, and then shape the beveled places by working down the tapers of the two holes. Fasten it securely to the work bench by means of bolts. This is for light service, says the Blacksmith and Wheelwright. For heavier pipes and tubing a wooden form like Fig. 14 is useful, and may be bolted to a projection of the bench. Bend the pipe over as far as possible with the hands and then drop a loop of rope, M, over to hold it in place.

A set form bending device is shown at Fig. 15. The block for the base is cut out in the desired curve and a piece of hardwood, N, is shaped to correspond with the curve in the base and is fitted to the shaft P. The shaft can be raised and lowered, turning the crossbar as it is threaded.

Fig. 16 shows a revolving disk bending device. This consists of a small lower wheel of iron or steel having a shallow groove (just deep enough to grip the pipe) and a larger upper wheel, S, driven by a wheel for a belt as shown. Both the upper and lower wheels revolve in substantial wooden bearings on metal shafts. Pipe sleeves are used to line the bearings in which the shafts turn. The curve is made by running the pipe between the grooved wheels.

A grip form for pipe-bending is shown in Fig. 17. It is made of two pieces of hardwood, jointed at T, and having a series of holes of various sizes bored for receiving the tubing to be bent. The clamping arrangement is bolted to the bench and the pipe is held firm while being bent.

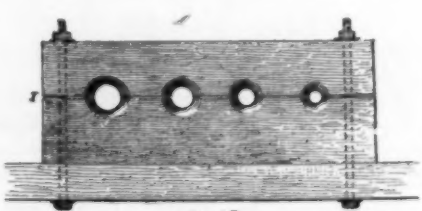
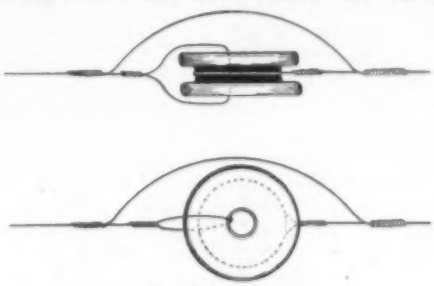


Fig. 17

TO STOP HUMMING OF TELEPHONE WIRES

The following is recommended as a positive cure for the humming of telephone wires.

Procure a porcelain spool insulator with a deep groove and place in the groove a rubber band (a piece of inner tube from a bicycle will do); then place around the rubber and in the groove the line wire, preferably insulated. Pass another piece of insulated wire through the hole in the insulator and make a connection as shown


Anti-Hum Device

in the sketch. With another piece of wire bridge around the connection so as to complete the circuit. The device is cheap and efficient.—Contributed by Walter La Homadue, Cherry Valley, N. Y.

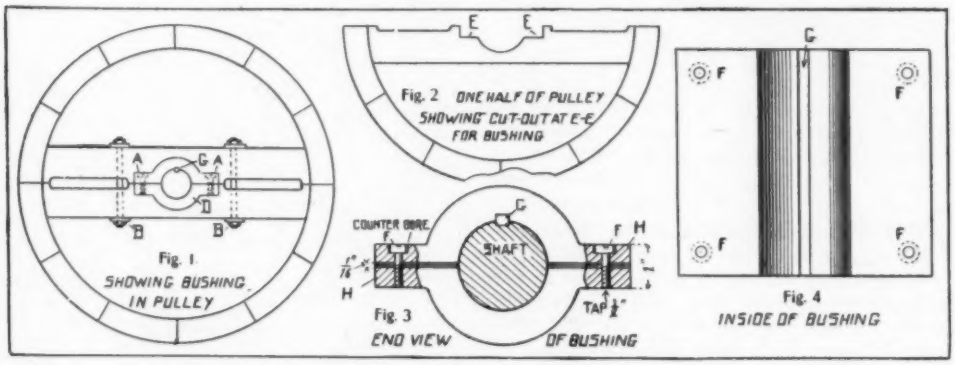
UNITED STATES STANDARD BOILER IRON THICKNESS

The following table gives the thickness of boiler iron required by the laws of the United States, for the various pressures given in each case. The Practical Engineer states these figures are for pressure equivalent to the standard for a boiler 42 in. diameter and one-quarter inch thick.

Thickness in fortieths	Diameter.						
	30 inches.	36 inches.	42 inches.	48 inches.	54 inches.	60 inches.	66 inches.
	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.	Pounds.
5	169.9	160.4	152.0	144.4	137.5	131.2	125.5
4½	158.5	149.7	141.8	134.7	128.3	122.5	117.2
4¼	147.2	139.1	131.8	125.1	119.2	113.7	108.8
4	135.9	128.3	121.6	115.5	110.0	105.0	100.0
3¾	124.5	117.6	111.4	105.9	100.8	96.2	92.0
3½	113.2	106.9	101.3	96.2	91.7	87.5	83.0
3	101.9	96.2	91.3	82.6	82.5	78.7	75.0

SAFE BUSHING FOR A WOOD SPLIT PULLEY

Oftentimes when a large wood pulley is tightened on a small shaft, it is a hard matter to keep it from slipping, especially a new pulley, where it would only take a few minutes work to cut a keyway in the shaft with a cold chisel without taking down a section of shafting.



Make an iron bushing of forged or cast steel to fit the hole for the former wood bushing, with two projecting lugs as at H H, Fig. 3. Cut out the pulley on each side of the hole as at E E, Fig. 2, to make a place into which the bushing will fit.

Drill four holes in the bushing, two at each side as at F F, Fig. 4, and tap ½ in. or larger in one-half of the bushing for blind cap screws.

Bolt the two halves of the bushing together and bore them out the size of the shaft. Put pasteboard between the halves before boring. Then keyseat and put on shaft over key at G, Fig. 3.

This bushing can be made from a pattern, cast iron or steel, and as long as the web of the pulley it is used with. This is a good method where a large pulley has to transmit power to a heavy load.

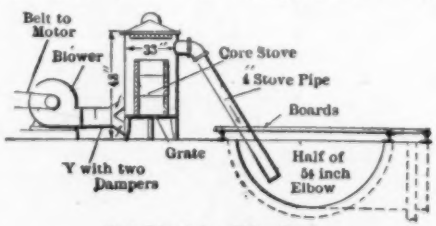
Fig. 1 shows bushing in pulley at D, keyed on to shaft and bolts, B, B, all set.—Contributed by F. M. D., Rocks Falls, Ill.

Use a very soft iron for brass molds, as the best iron for the purpose is one that cuts easily. Common machinery iron is not at all adapted to the purpose, as it soon develops cracks on the surface of the mold casting.

HOT BLAST STOVE FOR SKIN-DRYING MOLD

A hot-blast stove used for skin-drying molds for large pipe castings is described by a correspondent of the American Machinist, who recommends it on the grounds of cheapness and high efficiency.

An ordinary coke stove (four gray-iron rings set up on a circular grate with four legs) is surrounded by a cylinder of No. 16 steel, 33 in. diameter, 48 in. high and fitted with a cover. The cylinder fits the grate casting. The stove has a Y inlet, each branch fitted with a butterfly damper, and at the top one outlet. Air is supplied to the heater by a small blower mounted on a plank and driven by a motor. The hot air is driven into the mold, as shown in the sketch. The combustion of the coke is controlled by means of the damper in the inlet under the grate. The half-mold shown in the sketch is covered with boards, sacking and sheet iron. The temperature in the mold will register 300 degrees F., and a bushel of coke will last ten hours, continuous run.



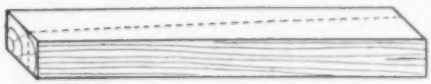
Hot Blast for Skin Drying

Many of the parts required for this stove will be found lying unused about the shop.

POPULAR MECHANICS balance of your life for - - - - - - $10.00
POPULAR MECHANICS five years, only - - - - - - - - $3.00

FENCE POSTS BOTTOM UPWARDS

Many years ago while engaged in running a saw mill in eastern Connecticut I had a lot of fence posts to saw from small chestnut logs. The posts were to be sawed tapering and to economize in lumber the logs were



Post Economy

first sawed square and then split diagonally like the accompanying diagram. Of course they were to be set in the ground large end down, which would bring one-half of them bottom up in regard to the position in which they grew.

I remembered hearing an old farmer say that posts set that way would outlast those set "right end up" and I determined to improve the opportunity at hand to test the matter. So I marked all the inverted ones and as the fence was to be built in the neighborhood I watched the result.

Examining the fence about nine years after it was built convinced me, as the inverted ones were practically sound while the others showed very much more decay.—Contributed by Andrew Whiton, Hartford, Conn.

LINOLEUM COVERS FOR WORK BENCHES

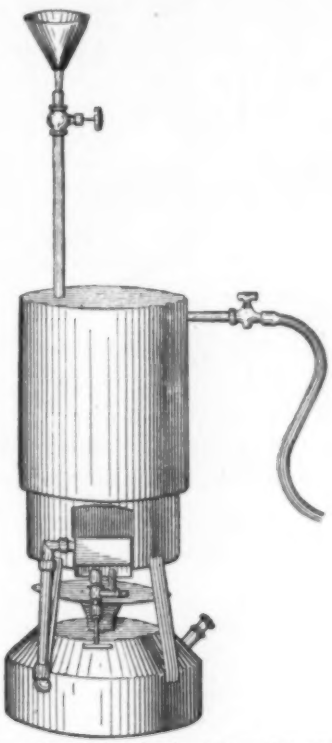
Heavy linoleum makes a fine covering for the tops of work benches, says a correspondent of the American Machinist. The bench may have a pine top instead of one of hardwood, but should be constructed quite as usual. Use tongued and grooved pieces for the top and fill all holes with plaster of paris. The linoleum costs about $1 per yard.

To fasten it to the bench glue the edge next the workman for about 3 in. and secure over night. Then trim the edge flush with the bench and hold the other edges in place with wooden strips arranged so the linoleum will move under them as the top of the bench shrinks. The linoleum is so stiff it will always lie flat and it will last for years. Two benches covered with it have been in use five years and though the covers are marred some, they are still in good order for work.

Is there anything you want but don't know where to get it? Write Popular Mechanics. Information free.

APPARATUS FOR THAWING OUT PUMPS

For thawing out frozen pumps, the handy portable apparatus shown in the illustration was contrived by a correspondent of the Metal Worker. It consists of an ordinary gas firepot with a galvanized iron can of suitable size, the top of which is provided with two outlets, made from small pieces of galvanized iron pipe soldered securely in place. One outlet stands vertically from the



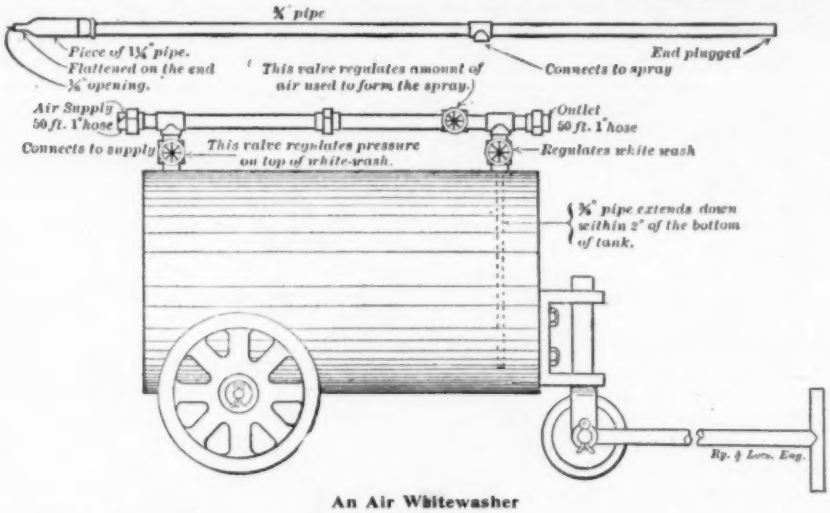
Thaws Ice 60 Feet Distant from Apparatus

top of the can and has a small globe valve on it, just above a T arranged to receive a safety valve. Above the globe valve is soldered a small funnel.

The other outlet is connected from the side of the boiler into a small valve, or petcock, which receives a rubber hose. To use the apparatus the boiler is heated until sufficient steam pressure is generated, when the hose is inserted in the pump, finds its way readily to the ice and the steam speedily thaws it. Ice 60 ft. distance from the boiler can be thawed in this way. Most shops contain all the materials required for such an apparatus.

AIR WHITEWASHER

A whitewasher operated by compressed air, says a correspondent of Locomotive Engineering, accomplishes in two hours an amount of work that would keep one man busy a month. The construction of the machine is fully explained in the illustration.

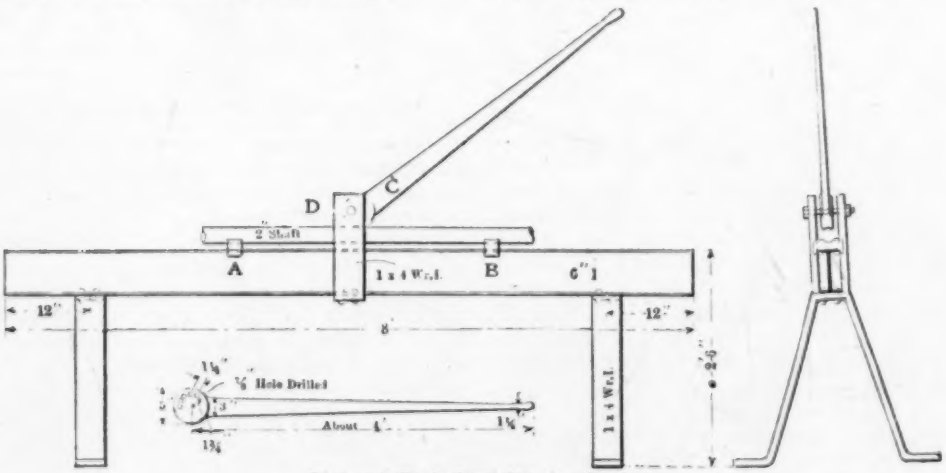

¾" pipe
Piece of 1¼" pipe. Flattened on the end ¾" opening.
This valve regulates amount of air used to form the spray.
End plugged
Connects to spray
Air Supply 50 ft. 1" hose
Connects to supply
This valve regulates pressure on top of white-wash.
Outlet 50 ft. 1" hose
Regulates white wash
¾" pipe extends down within 2" of the bottom of tank.
Ry. & Loco. Eng.

An Air Whitewasher

MACHINE FOR STRAIGHTENING PIPE AND SHAFTING

The press shown in the illustration can be used for straightening pipe and shafting or for bending pipe. The device was contrived by a correspondent of the American Machinist and in construction is very simple.

Blocks A and B are forgings fitted over the top of a 6-in. I-beam, so that they are free to move the length of the beam, which is 8 ft. long. C is a lever with the lower end enlarged and the edge ground some. One end of the lever acts as a center and can have any number of holes drilled in it. It is very easy to straighten 2-in. pipe in such a press.



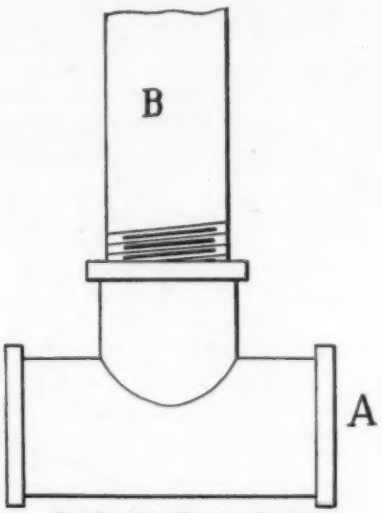
Pipe and Shaft Straightening Device

Rubbing with a piece of chamois leather or cotton flannel moistened with alcohol will readily reduce a too strong high light in a negative.

Shop Notes for 1905; 200 pages; 385 illustrations; price, 50 cents.

DEVICE FOR BENDING ELECTRIC CONDUIT

A device for bending the smaller sizes of electric conduit is made by screwing a piece of pipe into a tee, A. To use slip the tee over the conduit till it reaches the point where the bend is to be made. Then stand



For Bending Electric Conduit

on the conduit and pull or push handle B. Any curve can be bent in this way and different sized tees may be used for different sizes of conduits.—Contributed by John Weldon, 433 Columbia St., Brooklyn, N. Y.

HINTS ON GLUE

It requires more water to dissolve good glue than to dissolve poor glue. The best glue, says the Wood-Worker, will require from one-half to more than double the water required for poor glue.

Good glue breaks hard and tough, with a splintered edge.

Cleanse the glue kettle often.

Frozen glue is so porous that it can be made up at once.

IMPROVING A WASHER

A thick washer can be made out of an old nut or a thinner one can be made of a piece of sheet iron or a metal button, says Gas Power. A very simple and easily made washer is a ring made from a piece of wire of suitable thickness.

A GOOD FLUID PASTE

Dissolve 10 lb. gum arabic and 2 lb. sugar in the amount of water required. Then add 1¾ oz. nitric acid and heat to the boiling point. This liquid paste will not mould and dries to a transparent layer on the paper. The Western Painter says it is well adapted for the flaps of envelopes, fine bookbinders' work, etc.

TO FIND CENTER OF SHAFT WITHOUT CENTER PUNCH

Procure a block of wood 1 in. thick and with an auger bit bore a hole in the block until just the point of the bit shows through

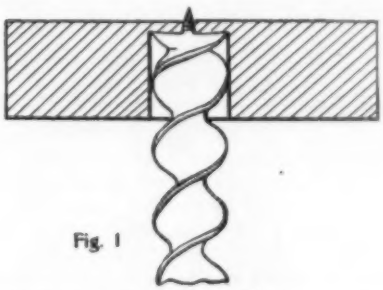


Fig. 1

the block as in Fig. 1. Then place block over the end of the shaft, Fig. 2, and with a sharp pointed punch and a hammer the center can

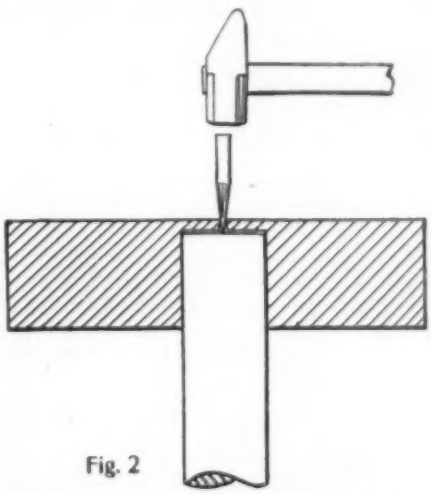
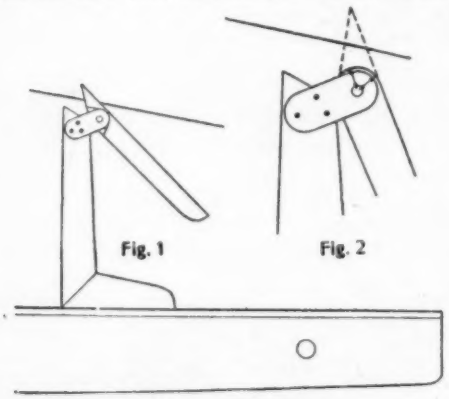


Fig. 2

be marked slightly. Then use a drill and drill out. The hole in the block must be the same size as the shaft.—Contributed by Eli Tolliver.

IMPROVING THE CLINOGRAPH

The clinograph is a set square used by draughtsmen for drawing inclined lines, section lines, and for shading, etc. It comprises two parts, one having two rectangular edges and another part, termed the "blade," which



Two Forms of Clinograph

is hinged to the first part. In using the appliance, one of the fixed edges is placed against the T-square and the blade adjusted to any position desired, where it is held by friction.

The instrument is slid along the T-square to any part of the drawing paper, for drawing parallel lines, says Technics, London, or for perpendicular lines, it is set and then turned with its other edge against the T-square. The illustration shows two forms of the clinograph. Fig. 1 shows a form in common usage, but the form shown at Fig. 2 is an improvement upon the first form, in which the edge can only be brought to coincide with a line by trial. In the second form the concentric portion is brought to the line and the blade swung around to coincide with the line without a trial. The alteration can be made with a pocket knife.

Has your boy a copy of Mechanics for Young America? Paper covers, 25 cents.

A GOOD STAPLE PULLER

A good staple puller that will do the work quickly and easily and leave the staples in better condition than such tools do ordi-

Fig. 1.

narily, is made of ½x½-in. steel; a correspondent of the Blacksmith and Wheelwright says he uses old harrow teeth for the purpose. The steel is first shaped as

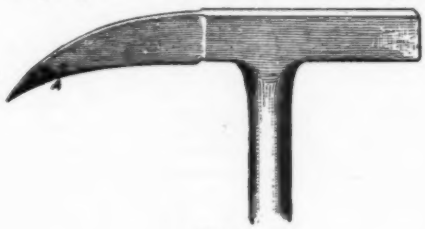


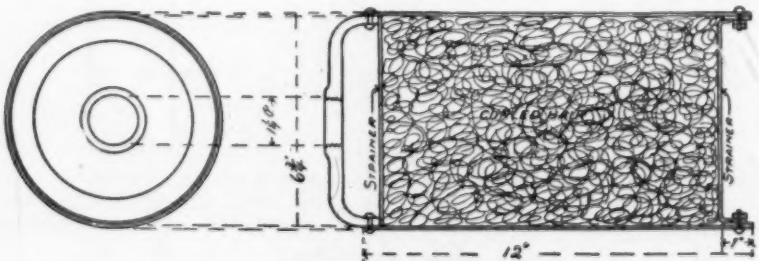
Fig. 2.

in Fig. 1, a bottom view, and then as in Fig. 2. The edges at A, Fig. 2, are rounded a little so they will not injure the wire. The handle may be of any length desired.

A sewing-machine that will sew directly from two reels of thread instead of using a spool of thread and a shuttle is the reputed invention of an Irishman. The machine is of simple mechanism and can be manufactured and sold at a greatly reduced price. Experts say the machine will revolutionize the sewing-machine trade of the world.

STRAINER FOR AIR PUMP

A strainer for the air cylinder of an air pump consists of curled hair held between two strainers. The device is screwed on the air cylinder and strains the dirt out of the air. A correspondent of Locomotive Engineering has used this strainer with excellent results.



Air Pump Strainer

DRIVING STAKES BY COMPRESSED AIR

A unique stake-driver and one that saves considerable hand labor is used by the Barnum and Bailey circus, says Air-Power. The apparatus consists of a rock drill suspended between two vertical guides. The two side rods of the drill are continued below the lower head and support a round anvil. This anvil rests on the head of the stake to be driven and holds it firmly by means of spring clasps. As the stake is driven into the ground the driver is lowered by means of a cylindrical hoist and follows the stake downward until it is driven in securely.

CROW BRIDGES FOR DRILLING HOLES IN DIFFICULT PLACES

For drilling holes in difficult places, the crow bridge can be used to advantage many times.

Fig. 1 shows how a crow or brace may be used. It is made of 1x1½ in. iron. The arms may be extended if required by two extension pieces, B.

When it is possible to pass a chain around the casting, cylinder, or material to be drilled, the crow may be used on work as in Fig. 2. Two holes are drilled at C C and the end link of a small chain passed through one, and a small bolt D pushed through the link to hold the chain. The chain is then passed around the work and pulled through the other hole until taut and fastened there with a small bolt.

The beauty of these crows, says a correspondent of the Engineer's Review, is that it is only necessary for an engineer to get hold of the bar iron. He can then shove it into his furnace fire, get a red heat on it and bend it as required. A couple of holes drilled completes the job and he has two handy tools.

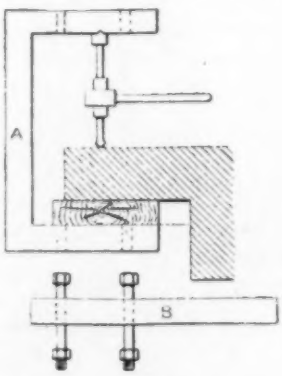


Fig. 1

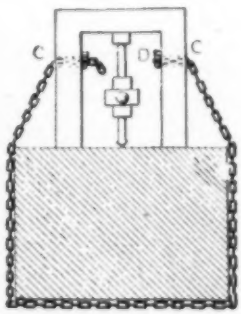
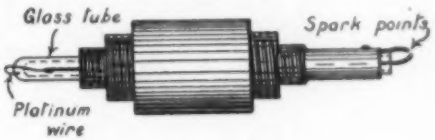


Fig. 2

HOW TO MAKE A SPARK PLUG FOR A SMALL GAS ENGINE

For a small gas engine (⅛ h. p.) a spark plug may be made and substituted for the ignition tube. A correspondent of the Model Engineer, London, tells how to make such a spark plug.

Fig. 1.—Spark Plug.



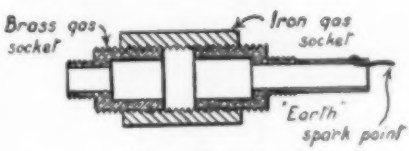


Fig. 2.—Section.

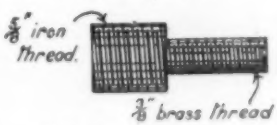


Fig. 3.—Brass Socket

Make a stuffing-box of three ordinary gas sockets, packing them with asbestos string moistened with paint. Insulate the "live" wire by a glass tube (Fig. 1), passing it through the stuffing-box. Connect the outer end of the "live" wire to a short piece of thin platinum wire and then hermetically seal this wire through the end of the glass tube. Pack the wire tightly in the tube with paint-moistened asbestos.

Rivet the "earth" spark point through a hole in the brass tube, which hole may be made by filing or turning off the lower part of the thread of the bottom brass gas socket (Fig. 3). Then bake the whole plug in the oven.

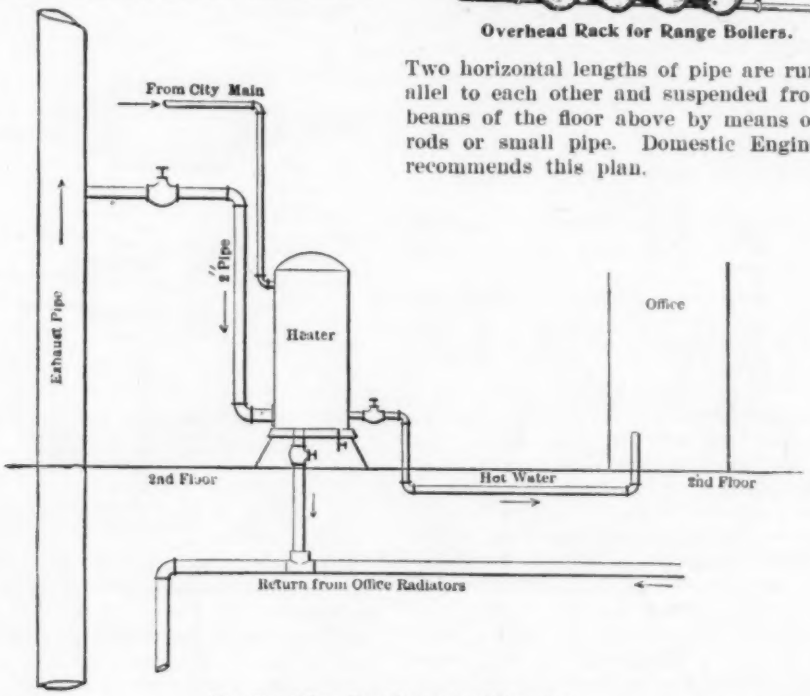
The spark plug screws into the ⅝-in. hole previously occupied by the ignition tube.

The mechanic with a just appreciation of economics will send $10 for a "Pop" life subscription.

HOT WATER FOR OFFICE USE

A system for heating water for office use was planned by a correspondent of Power. An old feed-water heater of the enclosed type, that had become too small for its original purpose was moved from the engine room to the second floor of the building and placed near the main exhaust pipe of the engine.

A 2-in. hole was tapped in the exhaust pipe and a pipe run from this hole to the heater. The outlet of the heater was connected to the return pipe of the radiators from the office. The cold water entered the heater from the city main at the top and the delivery was piped under the floor to the office, as shown.



For Providing Hot Water for Office Use.

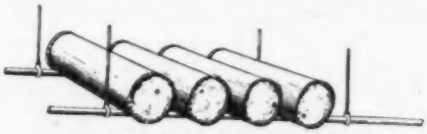
HOW TO REVIVE BURNT STEEL

A burnt tool may be revived so that it can be used in nearly every case, and if not the experiment has cost nothing, writes a correspondent of the Model Engineer.

Harden the tool in the usual way three times and then temper to the desired degree. This method can be used on hand tools, drills and small chisels with advantage.

STORING RANGE BOILERS

Range boilers not only take up considerable space in the shop, but are apt to suffer damage by being tipped over. The sketch shows a convenient means of storing them.



Overhead Rack for Range Boilers.

Two horizontal lengths of pipe are run parallel to each other and suspended from the beams of the floor above by means of iron rods or small pipe. Domestic Engineering recommends this plan.

TO APPLY ASBESTOS NEATLY

In applying asbestos about the steam plant a neat, quick method pays. The following is given by Machinery as such:

Make the asbestos plastic by mixing it thoroughly with water. Apply the first coat rough and about ½ in. thick, using a pointed trowel. Let dry and apply a second coat ¾ in. thick, and straighten down with a large trowel. Wind the second coat with No. 16 annealed wire, having the coils about 3 in. apart at all points. In case of a flat surface, bind it with horizontal wiring. Apply a third coat of asbestos to cover the wire and make a smooth surface. A 100-lb. bag of the material will cover about 40 sq. ft. of surface in this way.

SHARPENING DIGGING BARS

The method of sharpening the digging bars used for digging post holes, commonly is to give the point a bevel like a chopping or cold

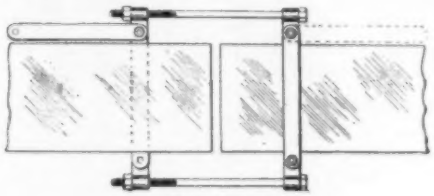
Two Ways of Sharpening Digging Tools

chisel. In hard or gravelly soil this shaped tool is apt to make a funnel-shaped hole and it is difficult to get the workmen to do any better with it.

A correspondent of the American Telephone Journal says that if the bar is beveled all on one side and the other side is left straight like a wood chisel this difficulty of funneled holes will be greatly overcome and that the men can make better time using this shaped tool.

HANDY BELT CLAMP

This simple and convenient clamp is made of ½-in. by 2-in. iron and is intended for belts not larger than 12 in. wide and ⅜ in. thick. The dimensions of the clamp can be increased in proportion for larger belts, however, says the Engineer's Review. The side



Belt Clamp

bolts of the clamp are of ⅞-in. stock, 24 in. long and the bolts clamping the crosspieces are of ½-in. stock, 2½ in. long with square heads.

In taking the clamp off, first slacken up on the long bolts, then on the small bolts and take two of them out.

To make new tin roofs hold paint well, give them a good rubbing with No. 1 sandpaper before applying the paint.

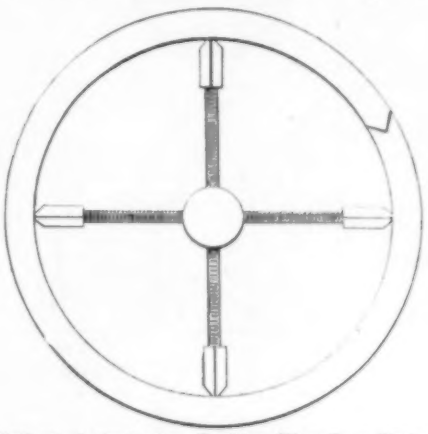
When paint is "tacky" try rubbing it with a cloth wet with ammonia.

SPRINGING PACKING RINGS OVER PISTON

In putting a snap ring on the piston of the high pressure cylinder of a tandem compound engine a correspondent of the Engineer's Review made use of the following kink. This job is very difficult for as soon as the ring is started on one side it slips off the other, and yet, for fear of breaking the ring the engineer must proceed cautiously.

Four pieces of square iron were cut off in 3-in. lengths and threaded to a depth of 2½ in. One end of each block was made tapering, coming down to a sharp point to prevent slipping of the ring surface.

Four bolts were threaded and screwed into these four blocks, which were placed in position as shown in the illustration. To put the



Method of Springing Packing Ring Over Piston

ring on the piston, the bolts and blocks were put in place and tightened up so as to spring the ring evenly until it was large enough to slip on over the piston.

MIXING CONCRETE

A concrete mixture of the following proportions is recommended by engineers.

To 1 bbl. Portland cement add 3 bbl. clean, sharp sand. Mix the two intimately, either manually or by a mechanical mixer. Add enough water to bring it to the proper consistency, the amount required being judged by one of experience in the work. Add 5 bbl. of broken stone and intermix the whole, which is then ready for use. This is known as a "1-3-5 mixture." The nature of the ingredients and the purpose for which the concrete is intended make the proportions variable, however.

HOW TO MAKE AN ELECTRIC ILLUMINATED FOUNTAIN

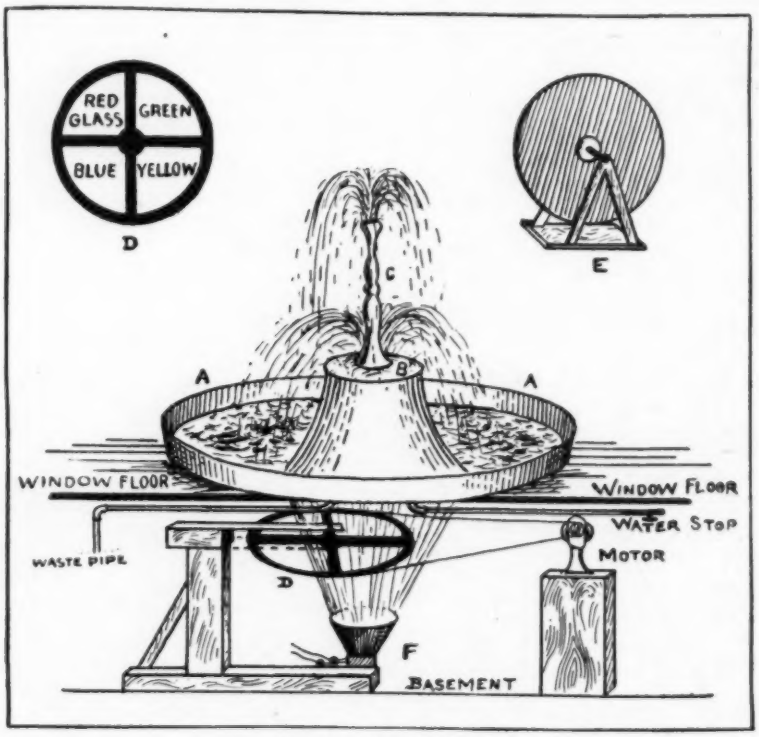
One of the prettiest and most attractive displays for a show window is an electric illuminated fountain. The Keystone tells how such a fountain may be constructed.

Have a tinsmith make the center bowl A of tin, of any size desired, according to the size of your window. This center bowl should be shaped like a large cake tin, hollow in the center. Cut a hole in the center of the window floor and place the tin bowl over it. Put a large rubber band around the center tin cone. Secure a circular glass shelf, B, having a hole in the center, and rest it upon the cone.

Have the tinsmith make a fancy stem, C, enamel it white, punch fine holes in it at the top and bottom and solder it to the water pipe, which passes through the hole in the center of the glass shelf and which is attached to the main pipe in the basement. Put a rubber washer on the glass shelf to make it watertight. The waterflow is regulated by water stop and the surplus is carried off through the waste pipe.

Make a skeleton pulley, D, with a piece of colored glass in each of its openings. Use red, green, yellow and blue glass and fasten it in position with tacks. Arrange this pulley so that half of it is in the center of the fountain.

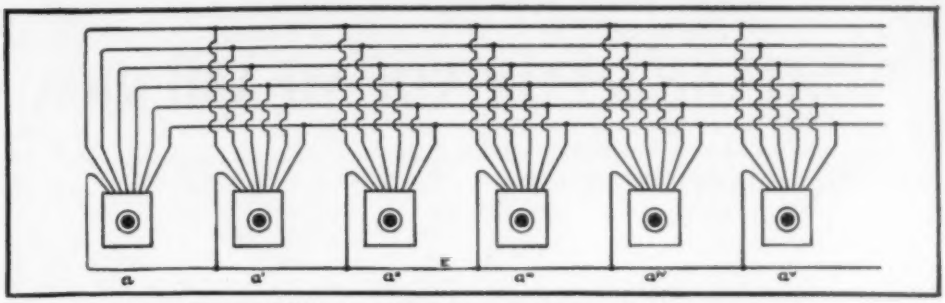
Place a strong electric light with a reflector in the position shown at F, so that it sends its rays upward through the colored glass and through the center cone on the water. The effect will be most beautiful. The changing of the colors can be reduced to speed by means of the reducer E. In the lower bowl lay three electric bulbs colored green, with wires made waterproof, well insulated and enameled. Pond lilies and gold fish may be added and a magnificent display created.



Electric Illuminated Fountain

A good cement for metal joints consists of ground white lead worked up with enough powdered red lead to bring it to the consistency of putty. Then add boiled linseed oil.

Our premium list is worthy of your attention. Write for it.



Plan of Wiring for Intercommunicating Telephone System

INSTALLING INTERCOMMUNICATING TELEPHONES---PLAN FOR SIX TELEPHONES

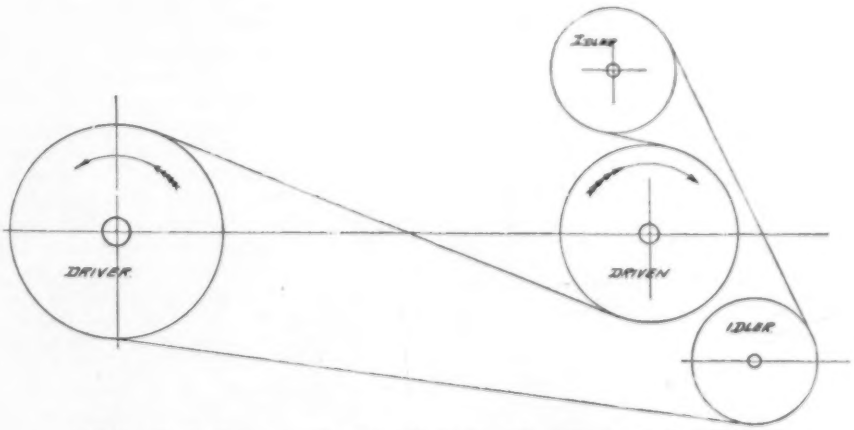
The approved plan of wiring for intercommunicating systems is shown in the accompanying diagram, which we reproduce by courtesy of the American Telephone Journal. The diagram shows six telephones, a, a′, a″, etc., to each of which six wires are run. The circuits are completed from the other terminals of each telephone, through the common return wire. The diameter of this return wire should equal the sum of the diameters of the separate wires, where the lines average over 1,000 ft. in length.

Switch board cable should not be used on the intercommunicating system because of creating mutual induction between two circuits, being twisted in pairs. Ordinary house wire, No. 19 B. & S. gauge, with a rubber insulation and a covering to match the woodwork along which it is run is recommended as best. Each separate wire should have a distinct color or combination.

ANOTHER METHOD OF REVERSING COUNTERSHAFT WITHOUT CROSSING BELT

Commenting on the article on reversing a countershaft without crossing the belt by means of two idlers, which appeared in the July Popular Mechanics, W. B. Burrows, of Minneapolis, Minn., says:

"The use of the two idlers for this purpose is all right, but according to my way of figuring they are not used correctly for the reason that the strain of the full load is brought on one of the idlers. I herewith submit a sketch of what I consider the better method for this kind of a drive, as it brings all the strain on the main shafts (where it belongs), leaving the idlers to simply guide the belt and carry the weight of the slack side, as well as allowing lighter shafts and bearings to be used for the idlers. I have used both ways, the latter up to 600 r. p. m., carrying a heavy, uneven load, and find that it gives a great deal better satisfaction all around."



"All the Strain Comes on the Main Shaft, the Idlers Merely Guide the Belt"

MECHANICS FOR YOUNG AMERICA

A PRACTICAL CAMERA FOR FIFTY CENTS

By C. H. Claudy

I say for fifty cents, but really this is an outside estimate. If you possess a few tools and the rudiments of a shop, by which is meant a few odds and ends of screws, brass and nails, you can really make this camera for nothing.

The camera box is the first consideration, and for this a cigar box answers every purpose. It is better to use one of the long boxes which contain a hundred cigars and which have square ends. This box should be cut down, by means of a saw and a plate, until the ends are four inches square. Leave the lid hinged as it is when it comes.

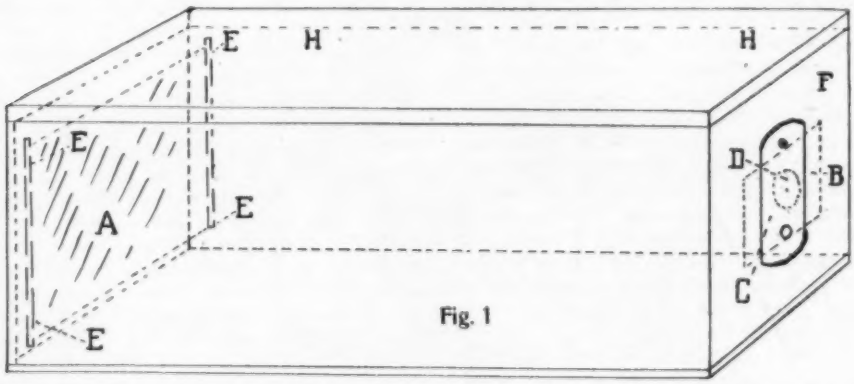


Fig. 1

Clean all the paper from the outside and inside of the box—which may be readily done with a piece of glass for a scraper and a damp cloth—and paint the interior of the box a dead black, either with carriage makers' black or black ink.

Now bore in the center of one end a small hole, a quarter of an inch or less in diameter. Finally insert on the inside of the box, on the sides, two small strips of wood, an eighth of an inch by a quarter and fasten them with glue, an eighth of an inch from the other end of the box. Examine Fig. 1, and see the location of these strips, which are lettered EE. Their purpose is to hold the plate, which may be any size desired up to four inches square. Commercially, plates come three and one-half by three and one-half, or, in the lantern slide plate, three and one-quarter by four inches. If it is desired to use the three and one-half by three and one-half, which is advised, the box should measure that size in its internal dimensions.

We now come to the construction of the most essential part of the camera—the pin hole and the shutter, which take the place of the lens and shutter used in more expensive outfits. This construction is illustrated in Fig. 4. Take a piece of brass, about a sixteenth of an inch thick and one and one-half inches square. Bore a hole in each corner, to take a small screw, which will fasten it to the front of the camera. With a quarter inch drill bore nearly through the plate in the center, but be careful that the point of the drill does not come through. This will produce the recess shown in the first section in Fig. 4. Now take a No. 10 needle, insert the eye end in a piece of wood and very carefully and gently twirl it in the center of the brass where it is the thinnest, until it goes through. This pin hole, as it is called, is what produces the image on the sensitive plate, in a manner which I shall presently describe. The shutter consists of a little swinging piece of brass completely covering the recess and pin hole, and provided with a little knob at its lower end. See Fig. 3, in which F is the front of the camera, B the brass plate and C the shutter. This is also illustrated in the second cross section in Fig. 4. In the

latter I have depicted it as swung from a pivot in the brass, and in Fig. 3 as hung from a screw in the wood of the front board; either construction will be effective.

Lastly, it is necessary to provide a finder for this camera in order to know what picture you are taking. Make a little frame of wire, the size of the plate you are using, and mount it upright (see Fig. 5) on top of the camera as close to the end where the pin hole is as you can. At the other end, in the center, erect a little pole of wire half the height of the plate. If now you look along the top of this little pole, through the wire frame and see that the top of the little pole appears in the center of the frame, everything that you see beyond will be taken on the plate, as will be made plain by looking at the dotted lines in Fig. 5, which represents the outer limits of your vision when confined within the little frame.

When you want to use this camera, take it into an absolutely dark room and insert a plate (which you can buy at any supply store for photographers) in the end where the slides of wood are, and between them and the back of the box. Close the lid and secure it with a couple of rubber bands. See that the little shutter covers the hole. Now take the camera to where you wish to take a photograph, and rest it securely on some solid surface. The exposure will be, in bright sunlight and supposing that your camera is ten inches long, about six to eight seconds. This exposure is made by lifting the little brass shutter until the hole is uncovered, keeping it up the required time, and then letting it drop back into place. It is important that the camera be held rigid during the exposure, and that it does not move and is not jarred—otherwise the picture will be blurred. Remove the plate in the dark room and pack it carefully in a pasteboard box and several wrappings of paper to protect it absolutely from the light. It is now ready to be carried to some one who knows how for development and printing.

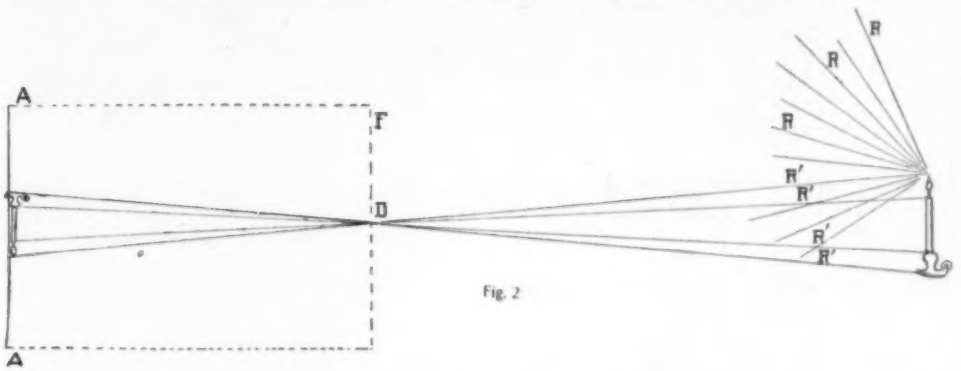


Fig. 2

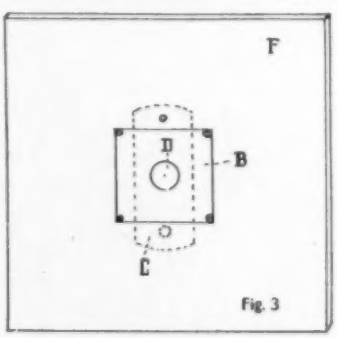


Fig. 3

Fig. 4

To explain the action of the pin hole I would direct attention to Fig. 2. Here F represents the front of the camera, D the pin hole, AA the plate and the letters RR, rays from a lighted candle. These rays of course, radiate in all directions, an infinite multitude of them. Similar rays radiate from every point of the object, from light reflected from these points. Certain of these rays strike the pin hole in the front of the camera, represented here by RRRR. These rays pass through the pin hole, and as light travels only in straight lines, reach the plate AA, forming an inverted image of the object, in this case a candle in a candlestick. Millions of rays are given off by every point in every object which is lighted by either direct or reflected light. To all practical purposes only one of these rays from each point in an object can pass through a minute opening, like a pin hole. This being so, any screen which interrupts these selected rays of light will show upon it a picture of the object, only inverted. If that screen happens to be a photographically sensitive plate, which is protected from all other

light by being in a dark box, upon it will be imprinted a photographic image which can be made visible by the application of certain chemicals, when it becomes a negative, from which may be printed positives. This camera is not a theoretical possibility, but an actual fact. I have made and used one successfully, as a demonstration of pin hole photography.

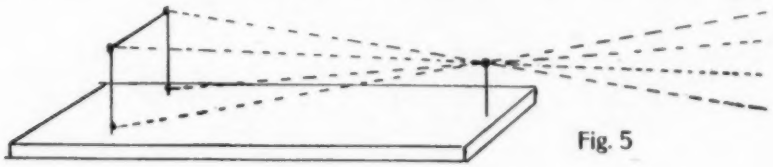


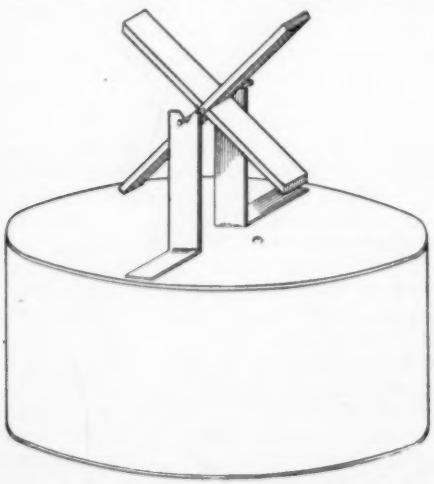
Fig. 5

HOW TO MAKE A VERY SIMPLE STEAM TURBINE

By A. L. Burkhart

A miniature steam turbine which is simpler in construction than the one described in the July issue of Popular Mechanics may be made as follows:

A tin can of quart size or larger may serve for the boiler. The can must have a good lid, so that it will not leak. In the top of the can, near one edge, punch a small hole. Through this hole the steam is to come out and strike the paddles of a small wheel. Make the wheel of two pieces of wood, fastened together by cutting halfway through the middle of each and then fitting each into the other, as every boy knows how to do to form a four-paddle water wheel. Drive a pin in each side to serve as a shaft. For the supports of the wheel use pieces of tin, bent into L-shape and soldered fast to the can. Place them in such position, with respect to the small hole punched, that the spurt of steam from the hole will strike the ends of the paddles of the wheel squarely. Fill the boiler three-fourths full of water, set it on a hot stove and as soon as steam is generated fast enough to come out the escape hole with slight force the wheel will start to revolve.



A Simple Turbine Engine

POWER OF SMALL COILS FOR SENDING WIRELESS MESSAGES

By O. F. Dame of the New England Coil Winding Company

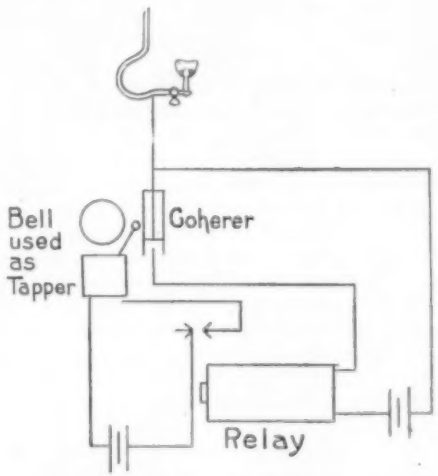
Hundreds of amateurs interested in wireless telegraph experiments are seeking definite information as to the sending power of small coils giving 1, 2, 3 and 4 in. sparks. As the successful operation of wireless apparatus depends considerably upon the efficiency of the receiving apparatus, there is absolutely no rule that can be laid down specifically, each man's experience differing from that of nearly everyone else.

Calculations based on recent experiments made by ourselves between two points three miles apart, over an uninterrupted stretch of water, and later from one hill to another, a mile distant, tend to show that one can send twice the distance over water that he can over land. In tests made at Atlantic, Mass., the minimum sending power required for one mile was ½-in. spark, and it was found that the maximum sending distance of an ordinary 2-in. spark coil operated by six cells of dry battery with no intensifying jars attached, was three miles. In these tests a glass tube coherer of the Marconi type was used. Each station was provided with a short pole, 15 ft. high, and a ground wire buried in moist earth. By the addition of Leyden jars and a more sensitive receiving device the same coil was used successfully a distance of eight miles over water.

It will therefore be seen that it is impossible for a coil manufacturer to state how much of a spark a customer will require for an estimated distance, without a thorough knowledge of the apparatus to be used at the receiving end, the location of the stations, and what is undoubtedly of more importance than anything else, the natural cleverness of the amateur in handling the subject. Wireless experiments furnish excellent opportunities for a man to exercise his ingenuity to the fullest extent. While it is true, that the induction coil is one-half of the outfit, a sensitive receiving device is equally necessary. The glass tube coherer was the first successful receiver and is used today by the United States government at some stations, and in locations where the stations are not thickly established will serve admirably for years to come. Wireless enthusiasts who have advanced in their experiments to a point where the coherer is discarded for the electrolytic or magnetic receivers, find small sparks rightly operated very successful over distances double that of the coherer period. It is safe, therefore, to assume that a 2-in. coil properly established is a suitable transmitter within the limits of a township, and a 3 or 4-in. coil sufficient for wireless communication of a more advanced character. The literature on wireless telegraphy, owing to the newness of the subject, overflows with questionable theories advanced by experimentalists whose researches lead them to think such and such things are so because certain experiments resulted that way. The future has in store so many undreamed-of discoveries that there seem to us to be very bright futures for the young students who master the principles while the thing is new.

RINGING A BELL BY TOUCHING A GAS JET

The experiment of scuffing the feet over a carpet and then producing a spark which will light the gas by touching the chandelier was given in the April Popular Mechanics. One of our correspondents, Frank C. Osborn, of New York City, says that if a wire is connected to the chandelier and led to one terminal of the coherer of a wireless tele-



Touch the Gas Jet and Ring the Bell

graph outfit the bell will ring every time the spark is produced by touching the chandelier, and that, as the chandeliers are all connected by the gas-pipe, the bell will ring, no matter in which room the spark is produced.

THE "BENNINGTON" DISASTER

The explosion of the boilers of the U. S. S. "Bennington" while in port at San Diego, Cal., has caused general adverse criticism by engineers and the public. Sixty-five sailors were killed or died from injuries. Had the explosion occurred a day later, when the vessel would have been at sea, her loss would doubtless have been one more of the "mysteries."

The generally accepted explanation is that the boilers were not only unsafe, but had been known to be in that condition for months past. It is far from creditable that the same critical boiler inspection which another branch of government so rigidly enforced against merchantmen could and should not prevail in its navy. Admiral Geo. W. Melville, chief of the bureau of steam engineering, says:

"It is passing strange that while we are wasting time and money on the boiler question, Great Britain is installing 23,000 horsepower of American boilers in their latest and greatest battleship that has been laid down by any navy in the world, the "Dreadnought." Great Britain has fought the "battle of the boiler" very much to her cost, and this greatest and most conservative navy in the world has selected an American boiler because in their service they have proved it to be the most economical, most reliable, smokeless and easiest kept in repair of any marine boiler in the world. Why should we not do likewise?"

CHEMISTRY FOR MECHANICS

By M. G. KOPF

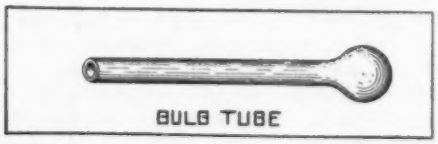
This is the first of a series of short lessons on practical chemistry, particularly adapted to the mechanic. The professional chemist is now considered indispensable in the larger manufacturing industries. We have the iron smelter sending samples of iron to the chemist, to be analyzed, so that he will be able to grade it as regards strength and purity. We have the food chemist, constantly in watch of our health. There is the agricultural chemist transforming arid deserts and wastes into productive farms and fields. In the shops we wonder why one tool breaks sooner than another, why some oils are better than others. We cannot all be chemists, but every one may easily obtain some knowledge of the science in its immediate relation to the things which are closely connected with his every-day work. These articles will all be written in plain simple language "so you can understand it."—Editor's Note.

PART I.

Before entering into details it would be well for one to know something about the history of chemistry. The word chemistry is probably derived from the word chemia, which is an old name for Egypt. The word simply signifies the Egyptian art; it was so called because chemistry was first practiced in Egypt. The development of chemistry has been through a series of long and tedious experiments. The Egyptians possessed, through their knowledge of chemistry, considerable skill in the arts of dyeing, painting and glass making; also in metallurgy. When the Arabs, in 640 A. D., invaded Egypt they became acquainted with the Egyptian sciences. A man called Geber wrote the first book on chemistry. He discovered a solvent for gold. After this chemistry advanced step by step until we now have a practical science.

For the first work the following articles will be needed. One may think there will be some difficulty in obtaining these, but on applying to a druggist he will give information as to the location of dealers in chemicals and chemical apparatus. Obtain five feet of 3/16 in. soft glass tubing; three inches of platinum wire; one 2-in. evaporating dish; one bunsen burner; one-half dozen small test tubes; one pair of tongs; three feet of ¼-in. pressure tubing; six inches of ¼, or preferably, 3/16 in. rubber connecting tubing; a small quantity of sulphur; some sugar; a small quantity of alcohol; some potassium sulphate; a piece of magnesium ribbon, and a test tube holder. All of these articles will come to about $1.50, but most of them will be needed in subsequent work. After obtaining all the above things provide a bench, which must be painted over with a thick coating of tar paint and located near a gas jet. Connect the burner with the jet by means of the three feet of ¼-in. pressure tubing. Turn on the gas and light it at the burner and it will be noticed that on admitting air, by means of the draft at the bottom of the burner, a blue, non-luminous flame will be produced, and that on turning the draft off, a luminous, white and smoky flame will result.

Now take a piece of glass tubing a foot long and cut it up into lengths of 4 inches. To do this procure a three-cornered file and with it make scratches at the places the tube is to be cut. Then place the thumbs on the side opposite the scratch and break the tube just as a stick is broken. Having cut the tubing into the proper lengths, and



adjusted the bunsen burner to give a non-luminous flame proceed to make a holder for the platinum wire and two bulb tubes. (See drawing.) Begin by rounding off the rough edges of the ends of the tubes. To do this hold the end of one of the tubes in the flame and watch closely until the edges melt, but do not hold long enough to make the bore of the tube smaller. Then on two of the tubes make bulbs. This is accomplished by holding the tube in the flame, as before, and rotating constantly until a lump of glass forms on the end. When the lump of glass is very hot withdraw the tube quickly from the flame and, rotating it at the same time, blow gently in the cool rounded end, until a bulb is formed from ⅜ to ½ in. in diameter. In the next chapter directions will be given for making "U" tubes of various shapes and also how to bend glass tubing.

Fuse the platinum wire in the remaining tube by holding the tube in the flame, and rotating, until the end is nearly closed. Then insert the platinum wire a quarter of an inch or so into the tube and heat, rotating at the same time until the glass has fused around the wire (See drawing).

By means of the glass handle hold the wire in a non-luminous flame. It gets white hot. Now withdraw it. It cools and is the same as before. Take a piece of magnesium ribbon and by means of the tongs hold it in the flame. It ignites and burns with a brilliant flame of a white color. A white powder is left, in no way resembling the magnesium ribbon. On heating the platinum wire we have a physical change; on heating the ribbon we have a chemical change. In a physical change we get back what we started with. In a chemical change we get a new substance.

Heat up some sugar in a bulb tube. The sugar gives off sweet smelling vapors turning black at the same time. Is this a chemical or physical change? This is a chemical change because a new substance carbon (C) is formed.

Place a teaspoon half full of powdered potassium sulphate (K_2SO_4) in a test tube and add about enough water (H_2O) to fill half way. When the K_2SO_4 is dissolved, add some alcohol (C_2H_5OH) drop by drop until a thick, white precipitate is formed. Drain off the H_2O and compare the precipitate with the original K_2SO_4. What kind of change has taken place? The precipitate tastes like the original K_2SO_4, therefore, to all appearances, a physical change has taken place.

Into the evaporating dish, partly full of water (H_2O), put a small piece of camphor (do not use moth balls); light it with a match. It burns into light, heat and smoke. These we cannot get back. Therefore a chemical change took place. Obtain some fine iron filings. To an equal amount of this add some sulphur. Mix thoroughly. Look at the gray mass with a lens. Put some of the powder into a test tube with H_2O, shake and allow to settle. Try the action of a magnet on the mass. Has a chemical change taken place? No, because in all cases there is still some iron and sulphur. Now cautiously heat some of the mixture in a test tube until the sulphur melts. Observe all the changes. While hot pour on some H_2O. The test tube will shatter and you will be able to get out the substance inside. Has a chemical change taken place? Yes, because the remaining substance is not acted upon by the magnet. You can see no more iron or sulphur. A new substance is formed, iron sulphide (FeS). So now we know what constitutes a chemical and physical change. Next we will take up elements, mixtures, compounds and the three states of matter.

(To be continued next month.)

PORTABLE ELECTRIC CONVEYER

A portable electric conveyer is used on a New York wharf where a great deal of perishable freight—fruits, vegetables, tobacco, etc.—is handled and is considered one of the most efficient aids to rapid handling of these cargoes. The conveyer is attached to a convenient socket and may be used either in the hold of the vessel or on the wharf. This machine handles freight with twice the dispatch of ordinary methods, says the Bulletin of the New York Edison Company. The illustration shows it on "the farm," or the place where garden truck is loaded on market wagons.

Portable Electric Conveyer

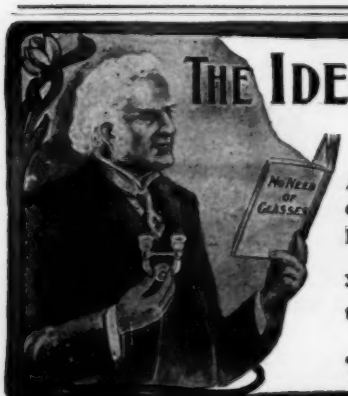
WE MANUFACTURE TO ORDER
DIES, TOOLS AND AUTOMATIC MACHINES
ALSO HARDWARE SPECIALTIES AND PATENTED NOVELTIES
ESTIMATES FURNISHED ON EXPERT MODEL WORK. SEND DRAWING OR SAMPLE.
BOOKLET FREE. WRITE TODAY.
Stamping & Tool Co.
DEP. C LA CROSSE, WIS.

COMPLETE DESIGNS of various size GAS ENGINES
3 in. x 3 in. Water Cooled - $1.00
4 in. x 5 in. Water Cooled (2 Cylinder) 1.50
4 in. x 5 in. Water Cooled (4 Cylinder) 2.00
These blue prints contain all details and dimensions necessary for the factory.
Address MUNROE & CO.
361 Houseman Bldg., - GRAND RAPIDS, Mich.

AUTO FOR RURAL FREE DELIVETY

Some of the 33,000 rural free delivery carriers are using automobiles instead of horses. They find that they can cover a 25-mile route, having the usual 150 boxes, in about two hours. To do the same work with a mail wagon drawn by horses takes about eight hours. The patrons along the route naturally like the more rapid service, as it brings them the daily market reports just that much earlier.

The illustration shows the auto free delivery on Route No. 2 out of Groton, S. D. It has been in service one year, except a short time in mid-winter when the regulation mail wagon and horses were substituted. The route is 32 miles long.



THE IDEAL SIGHT RESTORER
Is Your Sight Failing?
All refractive errors, muscular trouble and chronic diseases of the Eye successfully treated by scientific MASSAGE.
"I am in my seventy-ninth year, and have the Sight Restorer and yourselves to thank for renewed eye-sight." (Testimonial 177)
"I wish I could impress every one afflicted so they would give the Restorer a trial." (Testimonial 244)
English, German or Spanish pamphlet mailed free. Address
THE IDEAL COMPANY, 239 M Broadway, New York.